
TECHNICAL CATALOGUE
NBC
BEARINGS
In technical collaboration with NTN JAPAN

Certified ISO14001 by
Certified ISO/TS 16949 by

CATALOGUE/TC-101
July '2005

This version supersedes all previous ones. Please be informed that the bearings mentioned in this technical catalogue are normally manufactured in normal tolerance class, however, other class bearings can be supplied against specific requirements.

NBC
BEARINGS
NATIONAL ENGINEERING INDUSTRIES LTD.
Khatipura Road, Jaipur - 302 006

FOREWORD

This edition of the NBC Catalogue contains all necessary information and data required for selection of right bearing for specific applications. The data is based on International Standards laid down for the purpose and our manufacturing experience of more than 50 years.

Also our catalogue has been revised as per the latest IS/ISO standards for chamfer, dimensions, bearing accuracies, quality symbols and definitions.

National Engineering Industries Ltd. is the largest manufacturer of Ball & Roller Bearings, Steel Balls and Axle Boxes complete with Roller bearing in India, which are being produced in factories at Jaipur & Newai. Bearings are manufactured for every possible application and requirement of modern engineering industry and we continue to develop new sizes, keeping pace with rapid advancement in the Indian engineering industry.

NEI's technical collaborations with world's leading conglomerates in the field of Bearing technology viz. M/s NTN Corporation of Japan, M/s BRENCO Incorporated of USA have given a whole new dimension to the product range and a quality par excellence.

NEI has already implemented modern concepts of Total Quality Management and accredited QS9000 and TS16949 certification , NEI has also been awarded Association of American Railroads (AAR) for AAR certificate M-1003 for cartridge Tapered Roller Bearing in Feb 04-05. NEI has also been awarded ISO-14001 certificate for its concern & commitment towards a cleaner environment. NEI has successfully implemented SAP-ERP to re-engineer and integrate business processes to conform to world class standards.

We are confident that all users of NEI products will find a new presentation of this technical catalogue useful and informative and you are welcome to consult NEI for every assistance in selecting right bearing for any application that you have in mind.

For improvement as well as other reasons, the contents of this catalogue are subject to change without prior notice.

MILESTONES

1946	Company Established as National Bearing Company (NBC) under Technical Collaboration with Hoffman, U.K.
1950	Ball Bearing Production Started
1951	Railway Bearing Production Started
1957	Company name changed to National Engineering Industries Ltd. (Retaining NBC as Trade Mark)
1967	Tapered Roller Bearings Production Started under Technical Collaboration with Federal Mogul Corporation, U.S.A.
1971	Established Research & Development Division
1971	Established Machine Building Division
1975	Large Diameter Special Bearings Production Started
1976	Spherical Roller Bearings Production Started with Technical Know how from FAG-SRO
1981	Separate Factory for Ball Bearings at Gunsi (Newai)

1982	Cartridge Tapered Roller Bearings Production Started in Technical Collaboration with BRENCO Incorporated, U.S.A.
1985	Largest Bearing with Outer Diameter 1.3 Meter & Weight 4.39 Tons produced
1985	Technical Collaboration with NTN Corporation of Japan for Ball, Cylindrical & Spherical Roller Bearings
1990 to 95	Modernization in Three Phases
1995	ISO - 9001 Certificate
1996	Technical Collaboration with M/s Izumi Kinzoku Kogyo Co. Ltd., Japan for Machine Retrofitting/Remanufacturing and overhauling.
1997	Technical Collaboration with NTN Corporation of Japan for Tapered Roller Bearings and Hub Bearings
1998	IV Phase - Modernisation Started
1999	Implemented Ist Phase of SAP-ERP Solutions.
2000	QS-9000 & ISO-14001 Certification.
2003	TS-16949 Certification.
2005	AAR Certification M-1003 for Cartridge Tapered Roller Bearing.

CONTENTS

PAGE NO.

1. ROLLING BEARING CONSTRUCTION AND CLASSIFICATION **1**

1.1 Bearing Classification

2. BEARING DESIGNATION **5**

3. BEARING SELECTION **6**

4. LOAD RATING AND LIFE **7**

4.1 Basic Dynamic Load Rating and Life

4.2 Basic Static Load Rating

4.3 Life Factors for application

5. ACCURACY AND TOLERANCES **11**

5.1 Running Accuracy

5.2 Tolerances for Radial Bearings (Metric Series)

5.3 Tolerances for Tapered Roller Bearing (Metric Series)

5.4 Tolerances for Tapered Roller Bearing (Inch Series)

5.5 Chamfer Dimensions Limits for Roller Bearings

5.6 Basic Tapered Bore

6. BEARING INTERNAL CLEARANCE **21**

6.1 Internal Clearance Selection

6.2 Radial Internal Clearance Value

7. LUBRICATION **29**

7.1 Types of Lubrication

7.2 Methods of Oil Lubrication

1.	**SEATINGS LIMITS AND FITS**	**37**
8.1	Seatings	
8.2	Fits	
8.3	Limits and Fit guidelines	
9.	**BEARING HANDLING**	**43**
9.1	Mounting	
9.2	Dismounting & Replacement	
9.3	Bearing Cleaning	
9.4	Abutment for Bearing	
10.	**BEARING FAILURE**	**52**
10.1	Why Bearings Fail	
10.2	Bearing Damage & Corrective measures	
11.	**BEARINGS TABLES**	**56**
	Single Row Radial Ball Bearing	56-60
	Angular Contact Ball Bearing	61-62
	Self Aligning Ball Bearing	63-66
	Special Bearing Races	67
	Special Bearings	68
	Cylindrical Roller Bearing	69-76
	Single Row Tapered Roller Bearing (Inch Series)	77-89
	Double Row Tapered Roller Bearing	90
	Four Row Tapered Roller Bearing	91
	Thrust Bearing	92
	Spherical Roller Bearing	93

1. ROLLING BEARING CONSTRUCTION AND CLASSIFICATION

Rolling bearings are generally composed of bearing rings, rolling elements and cages. Several rolling elements are placed between two bearing rings and cages prevent the rolling elements from contact and with such a structure, a smooth rolling action becomes possible.

Rolling bearings are divided into radial bearings and thrust bearings, mainly depending on the applicable load direction. Radial bearing mainly take radial loads. Most types of radial bearings can also take thrust loads. Thrust bearings generally take thrust loads only and not radial loads.

Rolling bearings are largely divided into ball bearings and roller bearings in accordance with the types of rolling elements, Roller bearings are further divided depending on the shape of the roller into cylindrical roller bearings tapered roller bearings, spherical roller bearings and needle roller bearings. Ball bearings are divided into several types, depending on the shape of bearing rings and the contact position between the balls and the raceway.

The cages of rolling bearings are divided into pressed and machined ones with the shapes differing according to the bearings type and conditions of use.

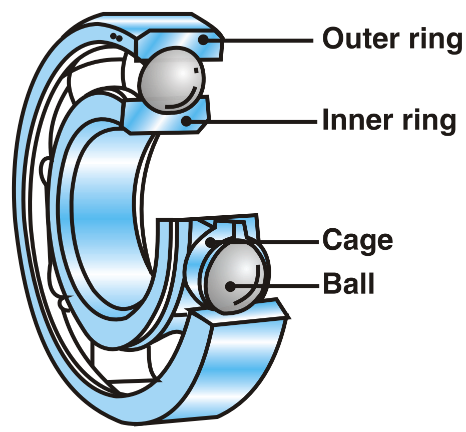
1.1 Bearing Classification

1.1.1 Single Row Radial Ball Bearings

The Single row radial ball bearings accommodate pure radial, pure axial or any combination of radial and axial loads within its capacity. These can operate at very high speeds. For these reasons and its economical price, it is the most widely used bearing.

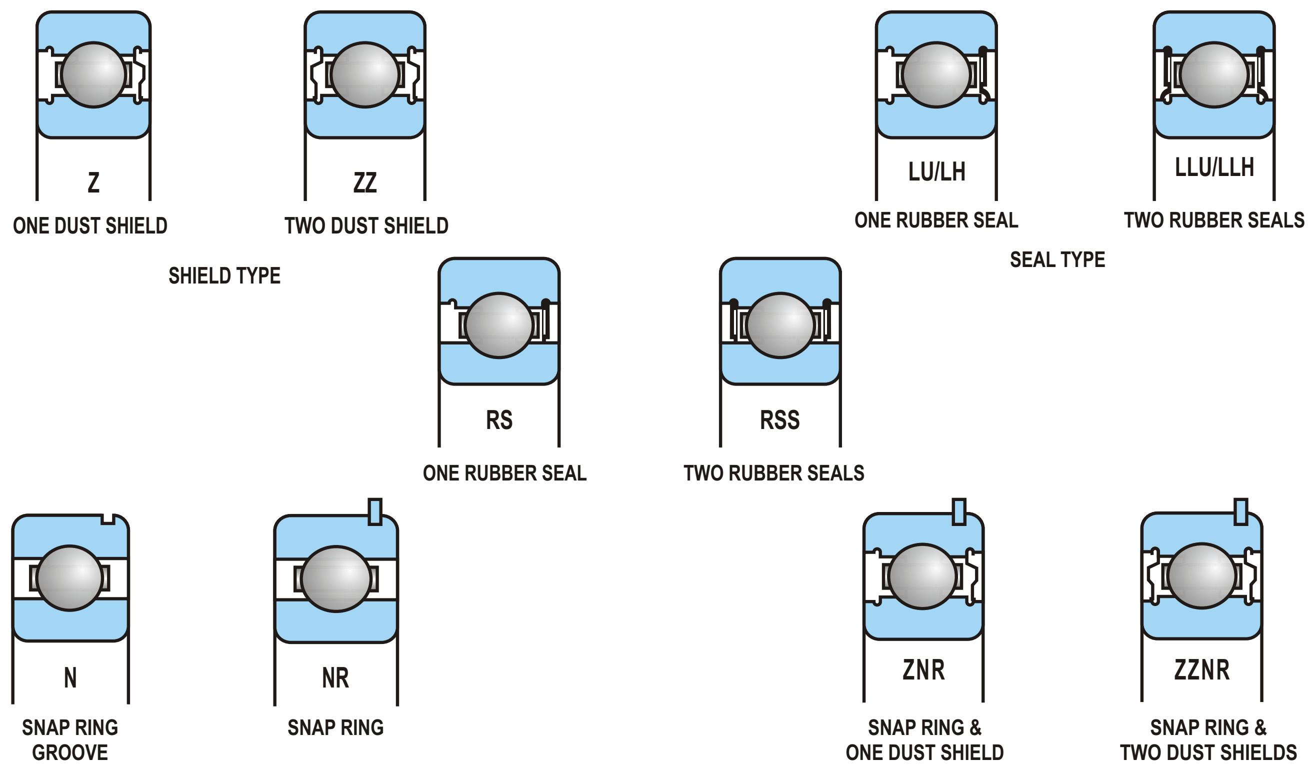
Owing to high degree of conformity between balls and raceways, the self aligning capability of deep groove ball bearings is small. This fact calls for well aligned bearing mountings.

These bearings can be located endwise in both the directions.



Deep Groove single Row Ball Bearing

Different variations in the type are as shown below :

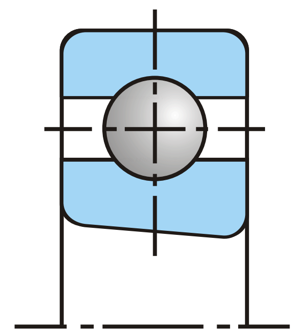


TMB Ball Bearings

TMB ball bearings have the same boundary dimensions as standard deep groove ball bearings, but have undergone a special heat treatment that considerably extends wear life. These bearings were especially effective in countering reduced wear life due to the effects of infiltration of dust and other foreign matter.

- TMB ball bearings' special characteristics are identical to standard ball bearings at rated loads, but with a bearing characterization factor of $a_2 = 2.2$
- TMB 62 series bearings can be used in place of standard 63 series bearings enabling lighter weight, more compact designs.

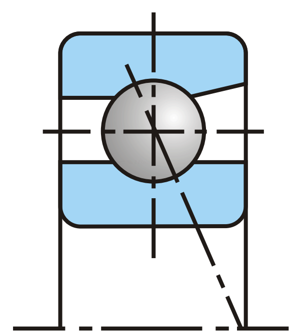
For dimensional specifications and other detailed information about TMB ball bearings, contact NEI Technical Cell.



SINGLE ROW RADIAL BALL BEARING WITH TAPER BORE

1.1.2 Single Row Radial Ball Bearing with Tapered Bore

The single row radial ball bearings with tapered bore are identical to single row radial ball bearings except that these have tapered bore which is used for easier mounting and for the adjustment of radial clearance.
Dimensions of tapered bore diameter refer to small bore.

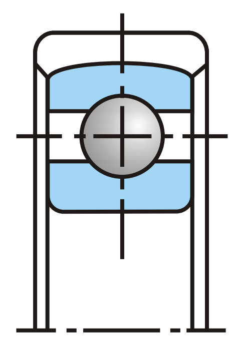


SINGLE ROW ANGULAR CONTACT BALL BEARING

1.1.3 Single Row Angular Contact Ball Bearing

The single row angular contact ball bearings have higher axial load capacity than the single row radial ball bearings. The radial load must always be less than axial load.

The bearings can carry axial load in one direction only and should be adjusted against another bearing, if axial load is coming from both the directions.
Each bearing can be located endwise in one direction only.



SINGLE ROW EXTERNALY ALIGNING BALL BEARING

1.1.4 Single Row Externally Aligning Ball Bearing

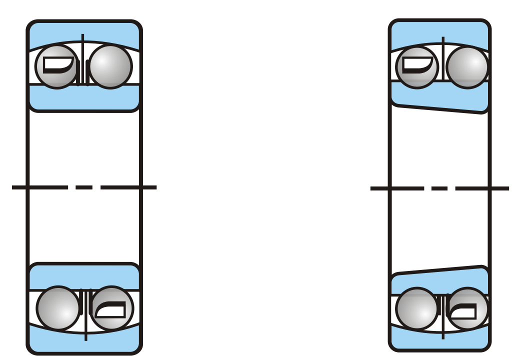
The single row externally aligning ball bearings are used where accurate alignment can not be guaranteed between bearing positions. It can take radial loads. Axial loads can also be accommodated.

The shell housing must not be made an interference fit on their outside diameter. If an interference fit is used, the shell housing may contract and prevent alignment.

These bearings can be located endwise in both the directions.

1.1.5 Double Row Self Aligning Ball Bearing

The double row self aligning ball bearings have the common outer spherical race for both the rows. This feature gives the bearings self aligning properties. The bearings have the same external dimensions as there equivalent single row radial ball bearings. They can take radial loads and very light axial loads. They can be located endwise in both the directions.

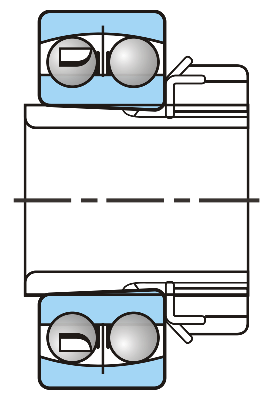


CYLINDRICAL BORE TAPERED BORE 1:12

Double Row Self Aligning Ball Bearing

1.1.6 Double Row Self-Aligning Ball Bearing with Tapered Clamping Sleeve and Nut

The double row self-aligning ball bearings with tapered clamping sleeve and nut are identical to double row self-aligning ball bearing except that these have a tapered bore, which is used for easier mounting and also a clamping sleeve and nut to clamp the bearings on the shaft. The tapered bore is also used for the adjustment of radial clearance.

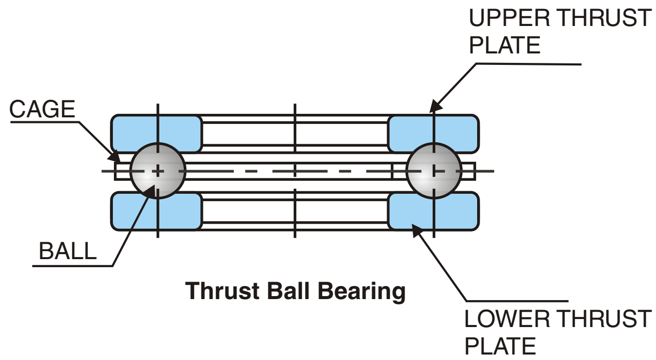


Double Row Self-Aligning Ball Bearing with Tapered Clamping Sleeve and Nut

1.1.7 Thrust Ball Bearing

The thrust ball bearings are used for high axial loads at low speeds. These can not operate at high speed as it will give rise to centrifugal or radial forces which can not be taken by the bearings.

They can be located endwise in one direction only.

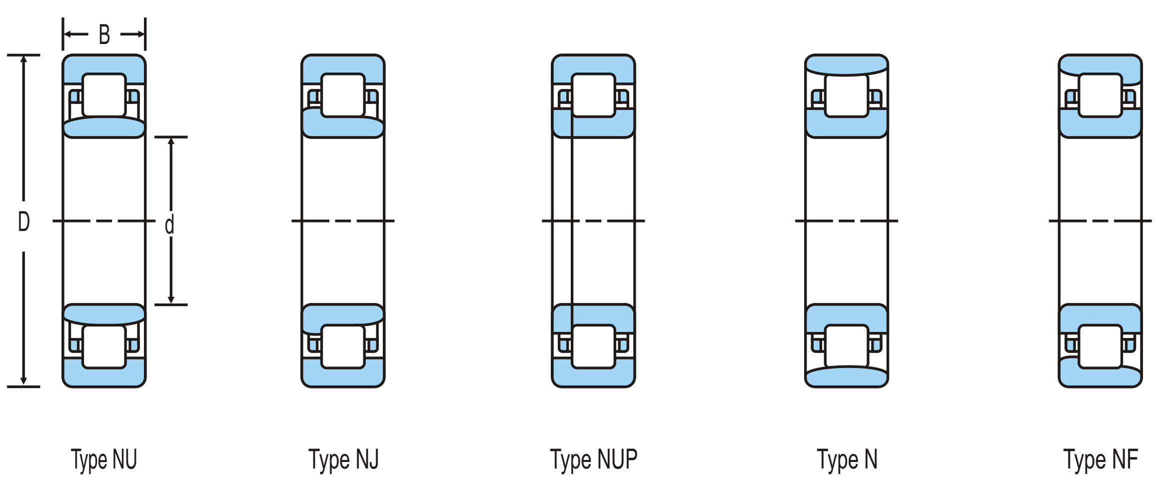


Thrust Ball Bearing

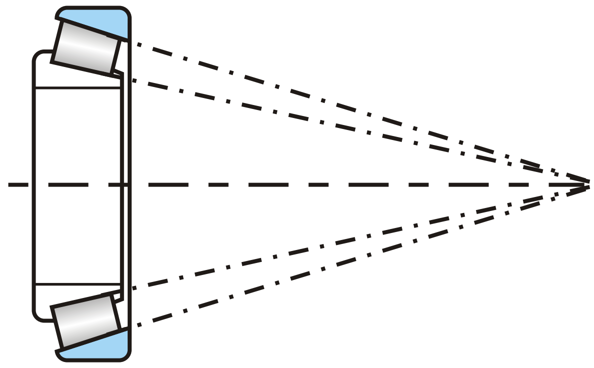
1.1.8 Cylindrical Roller Bearing

The cylindrical roller bearings have greater radial load capacity than ball bearings of same external dimensions and are particularly suitable for arduous duties. The bearing features a modified line contact between rollers and raceways to eliminate edge stressing. These bearings have a high radial load capacity and are suitable for high speeds. Due to detachable design character they have advantage of mounting inner ring and outer ring separately.

The direction of axial load which a bearing can take depending upon the geometry of the bearing. Many variations available are shown below :



1.1.9 Tapered Roller Bearing



Tapered roller bearings are designed in such a way that vertices of the cone for each roller and those for the inner and outer raceways coincides on the bearing axis or extensions of the raceways and rollers converge at a common point on the axis of rotation. This results in true rolling motion of the rollers on the raceways at every point along the rollers.

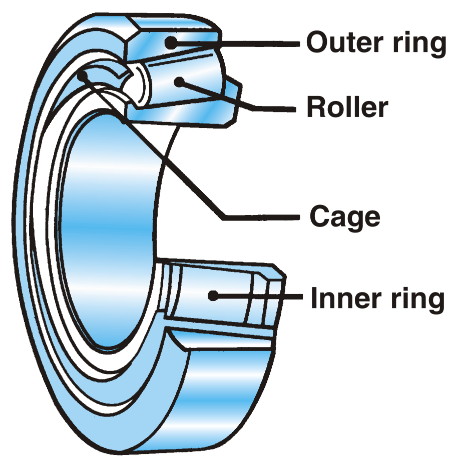
The tapered roller bearings support radial loads and axial loads from one direction only. The line contact between rollers and raceways provide the bearings with a high load carrying capacity. Steep angle tapered roller bearing with exceptionally steep cone angle enables the bearings to take heavier axial load.

The bearings are of separable type, enabling separate mounting of cups and cones.

Since the tapered roller bearings can absorb thrust loads in one direction only, these bearings should generally be installed as opposed mountings. The correct amount of radial and axial clearance is obtained by adjusting the two bearings against each other.

Besides, double row and four row tapered roller bearings are also widely used for heavy loads such as rolling mills.

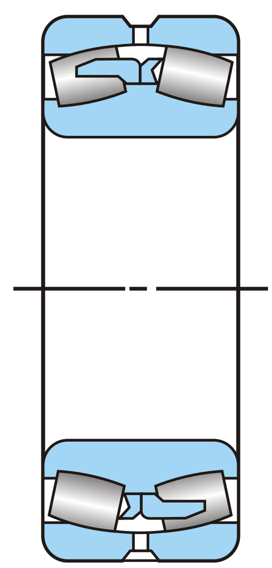
A single row tapered roller bearing can be located endwise in one direction only.



Tapered Roller Bearing

1.1.10 Spherical Roller Bearing

Spherical roller bearings are particularly suitable for carrying heavy loads. They are usually of the double row design, both of the rows of the rollers having common spherical raceways in the outer ring. This feature of this bearing has great practical importance in those cases where it is difficult to obtain exact parallelism between the shaft and housing both axes. So these bearings are suitable where misalignment can arise from mounting errors or from deflection of the shaft.



Spherical Roller Bearing

2. BEARING DESIGNATION

Rolling bearing part numbers indicate bearing type, dimensions, tolerances, internal construction & other related specifications. The first letter (digit) indicates the bearing type. The second digit indicates the width (or height) series & the third indicates the diameter series. The last two digits indicate the bore diameter by multiplying the last two digit by five for bearing having bore diameter original 40 mm & above. This method is applicable for metric series bearing only.

Example

6207 Z C3

- Radial internal Clearance C3
- Shielded (one side)
- Nominal bore diameter 35mm
- Diameter series 2
- **Deep groove ball bearing**

22328

- Nominal bore diameter 140mm
- Diameter series 3
- Diameter series2
- **Spherical roller bearing**

7212C

- Contact angle 15°
- Nominal bore diameter 60mm
- Diameter series 2
- **Angular contact ball bearing**

NU330C3

- Radial internal clearance C3
- Nominal bore diameter 150mm
- Diameter series 3
- **Cylindrical roller bearing NU type**

30204

- Nominal bore diameter 20mm
- Diameter series 2
- Width series 0
- **Tapered roller bearing**

1206K

- Tapered bore (1:12)
- Nominal bore diameter 30mm
- Diameter series 2
- **Self Aligning ball bearing**

3. BEARING SELECTION

The following procedure gives the steps to be followed when bearings are selected from the information contained in this catalogue. It will be found satisfactory for most applications, but to be sure, please consult the NEI Advisory Service.

1. a. Determine the speed of the bearing.
   b. Calculate the loads on the bearing.
2. Establish if accurate alignment can be obtained between the bearing seating. If it can not , then bearings that accommodate misalignment should be selected.
3. If the bearing is to rotate under load, decide the life required, calculate the required 'C' value, and then select suitable bearing that have comparable 'C' value.
4. Check if the bearing is suitable for the speed and decide if grease or oil is to be the lubricant.
5. Select a suitable bearing arrangement if this is not already known. Make sure that this arrangement is suitable to seating fits.
6. Finally
   a. decide whether 'Standard' or 'Extra Precision limit of accuracy is required.
   b. select the most suitable range of diametric clearance.
   c. choose the abutment diameters.
   d. choose suitable closures.
   e. issue mounting and handling instructions for the bearings if necessary.

Please consult NEI

i) if bearings are required in corrosion-resisting or in other special materials.
ii) it two bearings are mounted close together, special pairing of the two bearings may be necessary to ensure that they share the load.
iii) If the speed and temperature conditions are not provided for the information contained in this catalogue.

BEARING SELECTION BY NEI ADVISORY SERVICE

Our Engineers will be pleased to recommend the most suitable bearing and best method of mounting for any specified conditions. If you wish to use this service you should send all information relevant to your purpose on the following basis.

1. Provide a drawing or sketch showing layout of the parts involved and position in which the bearings are to be fitted, giving size of shaft and any dimensions limiting the space available.
2. Include a brief description of the mechanism if this is not clear from the drawing.
3. Give the speed and sufficient information, so that load on each bearing can be calculated accurately.
4. Indicate any unusual features such as the possibility of shock or vibration, unbalanced load, high temperature, or the presence of dirt, moisture or fumes.
5. Give the bearing life requirements and indicate whether the duty is continuous for 24 hrs. a day , or only intermittent. If intermittent, give periods of running and standing.
6. If the working conditions vary considerably, give the normal duty and also the peak conditions with the frequency and duration of peaks.
7. Say whether oil or grease lubrication is to be used.
8. Say whether the bearings can be lined up accurately or whether bearings with an aligning feature are required.

4. LOAD RATING AND LIFE

4.1 Basic Dynamic Load Rating and Life

Even in bearings operating under normal conditions the surface of the raceways and rolling elements are constantly being subjected to repeated compressive stresses which cause flaking of these surfaces to occur. This flaking is due to material fatigue and will eventually cause the bearing to fail.

The effective life of a bearing is usually defined in terms of the total numbers of revolutions a bearing can undergo before flaking of either the raceway surface or the rolling elements surfaces occurs.

When a group of apparently identical bearings operate under identical load conditions, the life of individual bearings show a considerable dispersion. Therefore, a statistical definition of the life is applied for the calculation of the bearing life. When selecting a bearing, it is not correct to regard the average life of all bearings as the criterion of life: It is more practical to adopt the life that the majority of bearing will attain or exceed.

For this reason the basic rating life of a group of bearings is defined as the number of revolutions (or hours at some given constant speed) that 90% of the group of bearings will complete or exceed before the first evidence of fatigue develops.

The basic dynamic load is defined as the constant stationary load which a group of bearings with stationary outer ring can endure for a rating life of one million revolutions of the inner ring. It refers to pure radial load for radial bearings and to pure axial load for thrust bearings.

The relationship among the bearing basic dynamic load rating, the bearing load and the basic rating life, is given by the following formula.

$$L_{10} = \left(\frac{C}{P}\right)^p$$

Where

- L_{10} = Basic rating life in millions revolutions
- C = Basic dynamic load rating, in Newton
- P = Equivalent dynamic load, in Newton
- p = exponent for the life formula
- p = 3 for ball bearings
- p = 10/3 for roller bearings

In many cases it is convenient to express the basic rating life in terms of operating hours rather than the number of revolutions, using the following procedure:

Where

- L_{10h} = $500\,(f_h)_p$
- f_h = $f_n \left(\frac{C}{P}\right)$
- f_n = $\left(\frac{33.3}{n}\right)^{1/p}$

Where

- L_{10h} = basis rating in hours of operation
- f_h = life factor
- f_n = speed factor
- n = operating speed, rev./min

The above formula may also be expressed as :

$$L_{10h} = \frac{10^6}{60n}\left(\frac{C}{P}\right)^p$$

The basic rating life can also be expressed in terms of kilometers for wheel bearings as shown in formula below :

$$L_{10S} = \frac{\pi D}{1000} \times L_{10}$$

Where D = Wheel diameter in mm

L_{10S} = Basic rating life in kms.

The value of f_n and the rating life for ball and roller bearing can be found by means of the diagrams given on page no. 8.

4.1.1 Adjusted life rating factor

The basic life rating (90% reliability factor) can be calculated through the formula mentioned above. However, in some applications a bearing life factor of over 90% reliability may be required to meet these requirements, bearing life can be lengthened by the use of specially improved bearing material or special construction technique. Moreover according to elastohydrodynamic lubrication theory, it is clear that the bearing operating conditions (lubrication, temperature, speed, etc.) all exert an effect on bearing life. All these adjustment factors are taken into consideration while calculating bearing life and using the life, adjustment factor as prescribed in ISO 281 , the adjusted bearing life is arrived at.

$$L_{na} = a_1 . a_2 . a_3 . \left(\frac{C}{P}\right)^p$$

Where,

- L_{na} : Adjustment life rating in millions of revolutions (10^6) adjusted for reliability material and operating conditions
- a_1 : Reliability adjustment factor
- a_2 : Material/construction adjustment factor
- a_3 : Operating condition adjustment factor

4.1.1.1 Life adjustment factor for reliability a_1

The values for the reliability adjustment factor a_1 (for a reliability factor higher than 90%) can be found from table given below :-

Reliability adjustment factor values

Reliability	Ln	Reliability factor a_1
90	L_{10}	1.00
95	L_5	0.62
96	L_4	0.53
97	L_3	0.44
98	L_2	0.33
99	L_1	0.21

Formula for factor a_1

a_1 = $4.48[Ln(100/R)]^{2/3}$

R = Reliability

L_n = Log Factor (Base 'e')

4.1.1.2 Life adjustment factor for material construction a_2

The value for the basic dynamic load rating given in the bearing dimension tables are for bearings constructed from NEI's continued efforts at improving the quality and life of its bearings.

Accordingly, a_2 = 1 is used for the adjustment factor in the formula. For bearings constructed of specially improved materials or with special manufacturing methods, the life adjustment factor a_2 in life can have a value greater than one.

When high carbon chromium steel bearings, which have undergone only normal heat treatment, are operated for long periods of time at temperatures in excess of 120°C considerable dimensional deformation may take place. For this reason, there are special high temperature bearings which have been heat treated for dimensional stability. This special treatment allows the bearing to operate at its maximum operational temperature without the occurrence of dimensional changes. However, these dimensionally stabilized bearings, designated with a 'TS' prefix have a reduced hardness with a consequent decrease in bearing life. The adjusted life factor values used in life formula for such heat-stabilized bearing can be found in Table given below

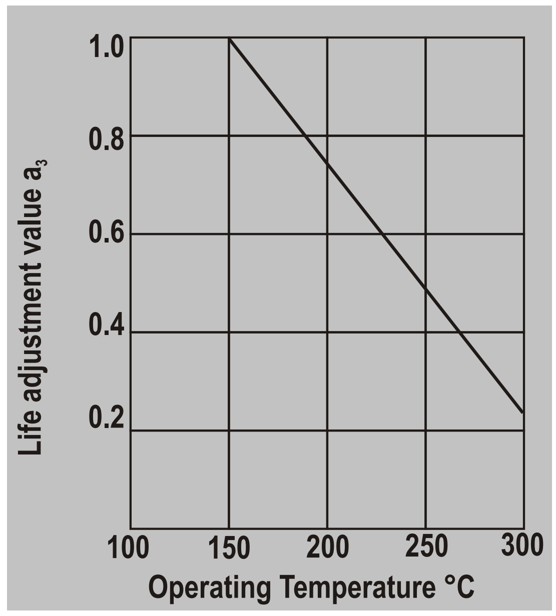
Code	Max. operating temperature °C	Adjustment factor a_2
TS2	160	0.87
TS3	200	0.68
TS4	250	0.30

4.1.1.3 Life adjustment factor a_3 for operating conditions

The operating conditions life adjustment factor a_3 is used to adjust for conditions such as lubrication, operating temperature, and other operation factors which have an effect on bearing life.

Generally speaking when lubricating conditions are satisfactory the a_3 factor has a value of one, and when lubricating conditions are exceptionally favourable, and all other operating conditions are normal a_3 can have a value greater than one.

However, when lubricating conditions are particularly unfavorable and oil film formation on the contact surfaces of the raceway and rolling elements is insufficient, the value of a_3 becomes less than one. This insufficient oil film formation can be caused, for example, by the lubricating oil viscosity being too low for the operating temperature (below 13 mm^2/s for ball bearing and below 20mm^2/s for roller bearings); or by exceptionally low rotational speed [n (r/min) x dp (mm) less than 10,000]. For bearings used under special operating conditions, please consult NEI.



Life adjustment value for operating temperature °C As the operating temperature of the bearing increases, the hardness of the bearing material decreases. Thus, the bearing life correspondingly decreases. The operating temperature adjustment values are shown in above figure.

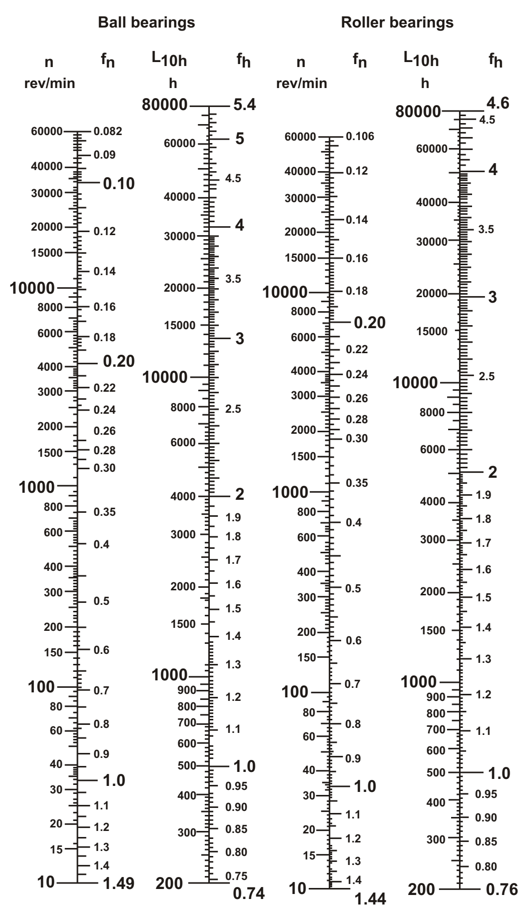


Fig. Diagram for basic rating life

4.2 Basic Static Load Rating

The Static load is defined as a load acting on a non-rotating bearing. Permanent deformation appears in rolling elements and raceways under static load of moderate magnitude and increases gradually with increasing load. The permissible static load, therefore, depends upon the permissible magnitude of permanent deformation.

Experience shows that total permanent deformation of 0.0001 times of the rolling element diameter, occurring at the most heavily loaded rolling element and raceway contact can be tolerated in most bearing applications without impairment of bearing operation.

In certain applications where subsequent rotation of the bearing is slow and where smoothness and friction requirements are not too exacting, a much greater total permanent deformation can be permitted. On the other hand, where extreme smoothness is required or friction requirements are critical, less-total permanent deformation may be tolerated.

For purpose of establishing comparative ratings, the basic static load rating therefore, is defined as that static radial load which corresponds to a total permanent deformation of rolling element and raceway at the most heavily stressed contact set at 0.0001 times of the rolling element diameter. It applies to pure radial load for radial bearing and pure axial load for thrust bearing.

In single row angular contact bearing, the basic static load rating relates to the radial component of the load, which causes a purely radial displacement of the bearing rings in relation to each other.

The maximum applied load values for contact stress occurring at the rolling element and raceway contact points are as follows :

For ball bearing	4200MPa
For self aligning ball bearing	4600MPa
For roller bearing	4000MPa

The static equivalent load is defined as that static radial load, which, if applied to Deep Groove Ball bearings, Angular Contact or Roller bearings would cause the same total permanent deformation at the most heavily stressed rolling element and raceway contact as that which occurs under the actual conditions of loading. For thrust bearings the static equivalent load is defined as that static, central, purely axial load which, if applied, would cause the same total permanent deformation at the most heavily stressed rolling element and raceway contact as that which occurs under the actual condition of loading.

4.3 Life Factor for Applications

Life factor f_h

Service Requirements	< 1.0	1.0-2.0	2.0-2.5	2.5-3.0	3.0-3.5	3.5-4.0	4.0-5.0	5.0
Machines used occasionally	Door mechanisms measuring instruments							
Equipment for short period or intermittent service interruption permission		Medical equipment	Household appliances, electric hand tools, agriculture machines, lifting tackles in shop					
Intermittent service machines high reliability				Power station auxiliary equipment, construction machines, Crane sheaves elevators, Conveyors, deck cranes, Cranes	Crane Sheaves			
Machines used for 8 hours a day but not always in full operation		Automobiles, motorcycles, internal grinding spindles, ore tub axles	Buses, Trucks	Wood working machines, gear drives, plunger pumps vibrating screens	Small electric motors, grinding spindles, boring machine spindles rotary crushers, industrial Wagon axles	Lathe spindles, press flywheels printing machines	Agitators important gear units	
Machines fully used for 8 hours			Small rolling mill rollnecks	Large rolling mill rollnecks, rolling mill table rollers, excavators centrifugal seperators continuous operation conveyors	Industrial electric motors, blowers, air conditioners street car or freight wagon axles, general machinery in shop, continuous operation cranes	Large electric motors, rolling mill gear units plastic extruders, rubber-plastics calendar rolls, railway vehicle axles, traction motors, conveyors in general use	Locomotive axles, railway vehicle gear units, false twist textile machines	
Machines continuously used for 24 hours a day					Loom	Electric motors in shop compressors, pumps	Textile machines, mine winches, iron industry conveyors	Papermaking machine, main rolls machines
Machines continuously used for 24 hours a day with maximum reliability pumps								Power station equipments, watersupply equipments for urban areas, mine drain

5. ACCURACY AND TOLERANCES

The accuracy of rolling bearings is classified as dimensional accuracy and running accuracy.

Dimensional accuracy indicates the tolerance and tolerance limits of boundary dimensions as well as the tolerance limits of width variations and of the taper of tapered bore. Running accuracy indicates the tolerance limits of outside cylindrical surface runout with side, radial runout, side runout with bore and axial runout.

5.1 Running Accuracy (As per ISO: 1132)

5.1.1 Radial Runout

Radial runout of assembled bearing inner ring, Kia (radial bearing): Difference between the largest and the smallest of the radial distances between the bore surface of the inner ring, in different angular positions of this ring, and a point in fixed position relative to the outer ring. At the angular position of the point mentioned, or on each side and close to it, rolling elements are to be in contact with both the inner and outer ring raceways and (in a tapered roller bearing) the cone back face rib, the bearing parts being otherwise in normal relative positions.

Radial runout of assembled bearing outer ring, Kea (radial bearing) : Difference between the largest and the smallest of the radial distance between the outside surface of the outer ring, in different angular positions of this ring, and a point in a fixed position relative to the inner ring. At the angular position of the point mentioned, or on each side and close to it, rolling elements are to be in contact with both the Inner and outer ring raceways and (in a tapered roller bearing) the cone back face rib, the bearing parts being otherwise in normal positions.

5.1.2 Face runout with raceway

Assembled bearing inner ring face runout with raceway, Sia (groove type radial ball bearing) : Differences between the largest and the smallest of the axial distances between the reference face of the inner ring, in different relative angular positions of this ring, at a radial distance from the inner ring axis equal to half the inner ring raceway contact diameter, and a point in a fixed position relative to the outer ring. The inner and the outer ring raceways are to be in contact with all the balls.

Assembled bearing cone back face runout with raceway, Sia (tapered roller bearing) : Difference between the largest and the smallest of the axial distances between the cone back face, in different angular positions of the cone, at a radial distance from the cone axis equal to half the cone raceway contact diameter and a point in a fixed position relative to the cup. The cone and cup raceways and the cone back face rib are to be in contact with all the rollers, the bearing parts being otherwise in normal relative positions.

Assembled bearing outer ring face runout with raceway Sea (groove type radial ball bearing) : Difference between the largest and the smallest of the axial distances between the reference face of the outer ring, in different relative angular positions of this ring, at a radial distance from the outer ring axis equal to half the outer ring raceway contact diameter, and a point in a fixed position relative to the inner ring. The inner and outer ring raceways are to be in contact with all the balls.

Assembled bearing cup back face runout with raceway Sea (tapered roller bearing) : Difference between the largest and the smallest of the axial distances between the cup back face, in different angular positions of the cup, at a radial distance from the cup axis equal to half the cup raceway contact diameter, and a point in a fixed position relative to the cone. The cone and cup raceways and the cone back face rib are to be in contact with all the rollers, the bearing parts being otherwise in normal relative positions.

5.1.3 Face runout with bore

Face runout with bore, S_d (inner ring reference face): Difference between the largest and the smallest of the axial distances between a plane perpendicular to the ring axis and the reference face of the ring, at a radial distance from the axial of half the inner ring raceway contact diameter.

5.1.4 Raceway parallelism with face

Raceway parallelism with face, S_i or S_e (inner or outer ring of groove type radial ball bearing reference face) : Difference between the largest and the smallest of the axial distances between the plane tangential to the reference face and the middle of the raceway.

5.1.5 Outside surface inclination

Variation of outside surface generatrix inclination with face, S_d (outer ring basically cylindrical surface reference face) : Total variation of the relative position in a radial direction parallel with the plane tangential to the reference face of the outer ring, of points on the same generatrix of the outside surface at a distance from the side faces of the ring equal to the maximum limits of the axial chamfer dimension.

5.1.6 Thickness-variation

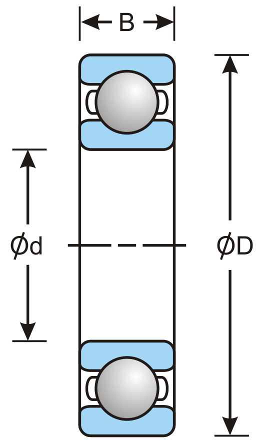
Inner ring raceway to bore thickness variation, K_i (radial bearing) : Difference between the largest and the smallest of the radial distances between the bore surface and the middle of a raceway on the outside of the ring.

Outer ring raceway to outside surface thickness variation, K_e (radial bearing) : Difference between the largest and the smallest of the radial distances between the outside surface and the middle of a raceway on the inside of the ring.

5.2 Tolerances For Radial Bearings (As per ISO : 492, IS:5692)

-Symbols

d = bearing bore diameter, nominal
d_1 = basic diameter at theoretical large end of a basically tapered bore
Δ_{ds} = deviation of a single bore diameter
Δ_{dmp} = single plane mean bore diameter deviation (for a basically tapered bore Δ_{dmp} refers only to the theoretical small end of bore)
Δ_{d1mp} = mean bore diameter deviation at theoretical large end of a basically tapered bore
V_{dp} = bore diameter variation in single radial plane
V_{dmp} = mean bore diameter variation (this applies only to a basically cylindrical bore)
$\propto$ = taper angle, nominal
D = bearing outside diameter, nominal
D_1 = outer ring flange outside diameter, nominal
Δ_{DS} = deviation of single outside diameter
ΔD_{mp} = single plane mean outside diameter deviation
V_{Dp} = outside diameter variation in a single radial plane
V_{Dmp} = mean outside diameter variation
B = inner ring width, nominal
Δ_{BS} = deviation of single inner ring width
V_{BS} = inner ring width variation
C = outer ring width, nominal
C_1 = outer ring flange width, nominal
Δ_{CS} = deviation of single outer ring width
Δ_{C1S} = deviation of a single outer ring flange width
V_{CS} = outer ring width variation
V_{C1S} = outer ring flange width variation
K_{ia} = radial runout of assembled bearing inner ring
K_{ea} = radial runout of assembled bearing outer ring
S_d = inner ring reference face (back face, where applicable) runout with bore
S_D = variation of bearing outside surface generatix inclination with outer ring reference face (back face)
S_{D1} = variation of bearing outside surface generatix inclination with flange back face
S_{ia} = assemble bearing inner ring face (backface) runout with raceway
Sea = assembled bearing outer ring face (backface) runout with raceway
Sea1 = assembled bearing outer ring flange backface runout with raceway



5.2.1 Tolerances for Normal Tolerance Class Radial Bearings (Except Tapered Roller Bearings) – METRIC SERIES

TABLE 5.2.1: INNER RING

Values in microns

d (mm)		Δ dmp		Vdp Diameter Series 9	0,1	2,3,4	Vdmp	Kia	ΔBS All	Normal	Modified	VBS
Over	Including	High	Low	Max			Max	Max	High	Low		Max
2.5	10	0	-8	10	8	6	6	10	0	-120	-250	15
10	18	0	-8	10	8	6	6	10	0	-120	-250	20
18	30	0	-10	13	10	8	8	13	0	-120	-250	20
30	50	0	-12	15	12	9	9	15	0	-120	-250	20
50	80	0	-15	19	19	11	11	20	0	-150	-380	25
80	120	0	-20	25	25	15	15	25	0	-200	-380	25
120	180	0	-25	31	31	19	19	30	0	-250	-500	30
180	250	0	-30	38	38	23	23	40	0	-300	-500	30
250	315	0	-35	44	44	26	26	50	0	-350	-500	35
315	400	0	-40	50	50	30	30	60	0	-400	-630	40
400	500	0	-45	56	56	34	34	65	0	-450	-	50
500	630	0	-50	63	63	38	38	70	0	-500	-	60
630	800	0	-75	94	94	55	55	80	0	-750	-	70
800	1000	0	-100	125	125	75	75	90	0	-1000	-	80

TABLE 5.2.2: OUTER RING

Values in microns

D (mm)		Δ Dmp		VDP Open Bearings Diameter Series 9	0,1	2,3,4	Capped Bearing 2,3,4	VDmp	Kea	ΔCS ΔC1S		VCS VC1S
Over	Including	High	Low	Max			Max	Max	Max	High	Low	Max
6	18	0	-8	10	8	6	10	6	15	Identical to ΔBS and VBS of Inner ring of same bearing		
18	30	0	-9	12	9	7	12	7	15			
30	50	0	-11	14	11	8	16	8	20			
50	80	0	-13	16	13	10	20	10	25			
80	120	0	-15	19	19	11	26	11	35			
120	150	0	-18	23	23	14	30	14	40			
150	180	0	-25	31	31	19	38	19	45			
180	250	0	-30	38	38	23	-	23	50			
250	315	0	-35	44	44	26	-	26	60			
315	400	0	-40	50	50	30	-	30	70			
400	500	0	-45	56	56	34	-	34	80			
500	630	0	-50	63	63	38	-	38	100			
630	800	0	-75	94	94	55	-	55	120			
800	1000	0	-100	125	125	75	-	75	140			
1000	1250	0	-125	155	155	94	-	94	160			
1250	1600	0	-160	200	200	120	-	120	190			
1600	2000	0	-200	250	250	150	-	150	220			
2000	2250	0	-250	310	310	190	-	190	250			

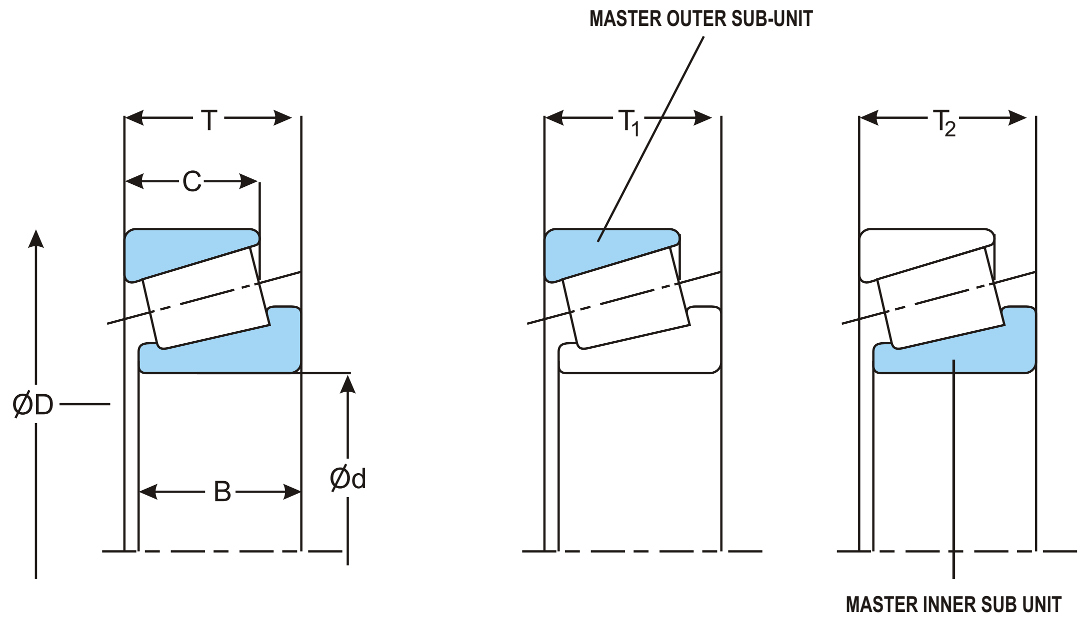
5.2.2 Tolerances For Radial Roller Bearings

Tapered Roller Bearings

- FOR METRIC SERIES AS PER ISO 492 / IS : 7460 STANDARDS
- FOR INCH SERIES AS PER ISO/578 STANDARDS.

Symbols

d	=	bearing bore diameter, nominal
Δds	=	deviation of a single bore diameter
Δdmp	=	single plane mean bore diameter deviation (for a basically tapered bore Ddmp refers only to the theoretical small end of bore)
Vdp	=	bore diameter variation in single radial plane
Vdmp	=	mean bore diameter variation (this applies only to a basically cylindrical bore)
D	=	bearing outside diameter, nominal
D1	=	outer ring flange outside diameter, nominal
ΔDs	=	deviation of a single outside diameter
ΔDmp	=	single plane mean outside diameter deviation
VDP	=	outside diameter variation in a single radial plane
VDmp	=	mean outside diameter variation
B	=	inner ring width, nominal
T	=	bearing width, nominal
ΔTs	=	deviation of the actual bearing width
T1	=	effective width of inner sub-unit, nominal
ΔBs	=	deviation of single inner ring width
C	=	outer ring width, nominal
ΔCs	=	deviation of single outer ring width
Kia	=	radial runout of assembled bearing inner ring
Kea	=	radial runout of assembled bearing outer ring
Sd	=	inner ring reference face (backface, where applicable) runout with bore
SD	=	variation of bearing outside surface generatix inclination with outer ring reference face (back face)
Sia	=	assemble bearing inner ring face (backface) runout with raceway
Sea	=	assembled bearing outer ring face (backface) runout with raceway
ΔT1s	=	deviation of the actual effective width of inner sub unit
T2	=	effective width of outer sub-unit, nominal
T2s	=	deviation of the actual effective width of outer sub-unit



SYMBOLS FOR TAPERED ROLLER BEARINGS

5.3 Tolerance For Tapered Roller Bearing (METRIC SERIES)
NORMAL TOLERANCE CLASS

5.3 Metric Series (ISO 492)

TABLE 5.3.1 - INNER RING

Tolerance value in microns

d (mm)		Δ dmp		Vdp	Vdmp	Kia
Over	Including	High	Low	Max	Max	Max
10	18	0	-12	12	9	15
18	30	0	-12	12	9	18
30	50	0	-12	12	9	20
50	80	0	-15	15	11	25
80	120	0	-20	20	15	30
120	180	0	-25	25	19	35
180	250	0	-30	30	23	50
250	315	0	-35	35	26	60
315	400	0	-40	40	30	70

TABLE 5.3.2 - OUTER RING

Tolerance value in microns

D (mm)		Δ Dmp		VDp	VDmp	Kea
Over	Including	High	Low	Max	Max	Max
18	30	0	-12	12	9	18
30	50	0	-14	14	11	20
50	80	0	-16	16	12	25
80	120	0	-18	18	14	35
120	150	0	-20	20	15	40
150	180	0	-25	25	19	45
180	250	0	-30	30	23	50
250	315	0	-35	35	26	60
315	400	0	-40	40	30	70
400	500	0	-45	45	34	80
500	630	0	-50	50	38	100

TABLE 5.3.3 WIDTH - INNER AND OUTER RING, SINGLE ROW BEARING AND SINGLE ROW SUBUNITS

Tolerance value in microns

d mm		Δ Bs		Δ Cs		Δ Ts		Δ T1s		Δ T2s	
Over	Including	High	Low	High	Low	High	Low	High	Low	High	Low
10	18	0	-120	0	-120	+200	0	+100	0	+100	0
18	30	0	-120	0	-120	+200	0	+100	0	+100	0
30	50	0	-120	0	-120	+200	0	+100	0	+100	0
50	80	0	-150	0	-150	+200	0	+100	0	+100	0
80	120	0	-200	0	-200	+200	-200	+100	-100	+100	-100
120	180	0	-250	0	-250	+350	-250	+150	-150	+200	-100
180	250	0	-300	0	-350	+350	-250	+150	-150	+200	-100
250	315	0	-350	0	-350	+350	-250	+150	-150	+200	-100
315	400	0	-400	0	-400	+400	-400	+200	-200	+200	-200

5.4 Tolerance For Tapered Roller Bearing (Inch Series)

Inch sizes (As per ISO/578 Specifications)

TABLE 5.4.1 INNER RING BORE, INNER RING WIDTH AND BEARING WIDTH

Tolerance class	d		Δ ds		Δ BS		Δ Ts	
	Over	Including	High	Low	High	Low	High	Low
	Inch		Value in 0.0001 inch					
4	0	3	+5	0	+30	-100	+80	0
	(3)	4	+10	0	+30	-100	+80	0
	(4)	6	+10	0	+30	-100	+140	-100
3	0	6	+5	0	+30	-100	+80	-80
0	0	6	+5	0	+30	-100	+80	-80
00	0	6	+3	0	+30	-100	+80	-80
	mm		Value in 0.001 mm					
	0	76.2	+13	0	+76	-254	+203	0
4	76.2	101.6	+25	0	+76	-254	+203	0
	101.6	152.4	+25	0	+76	-254	+356	-254
3	0	152.4	+13	0	+76	-254	+203	-203
0	0	152.4	+13	0	+76	-254	+203	-203
00	0	152.4	+8	0	+76	-254	+203	-203

NOTE : The Cage may project beyond the bearing width.

TABLE 5.4.2 OUTER RING OUTSIDE DIAMETER, OUTER RING WIDTH AND ASSEMBLED BEARING RUNOUTS

Tolerance class	D		Δ DS		Δ cs		Kia Kea Max	Sia Sea Max
	Over	Including	High	Low	High	Low		
	Inch		Value in 0.0001 inch					
4	0	12	+10	0	+20	-100	20	20
	(12)	14	+20	0	+20	-100	20	20
3	0	12	+5	0	+20	-100	3	3
	(12)	14	+10	0	+20	-100	7	7
0	0	12	+5	0	+20	-100	1.5	1.5
00	0	10.5	+3	0	+20	-100	0.75	0.75
	mm		Value in 0.001 mm					
4	0	304.8	+25	0	+51	-254	51	51
	(304.8)	355.6	+51	0	+51	-254	51	51
3	0	304.8	+13	0	+51	-254	8	8
	(304.8)	355.6	+25	0	+51	-254	18	18
0	0	304.8	+13	0	+51	-254	4	4
00	0	266.7	+8	0	+51	-254	2	2

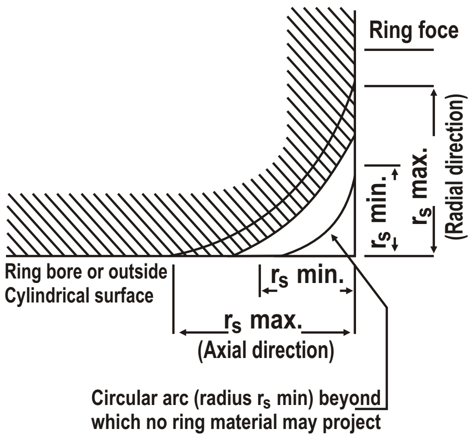
NOTE : The Tolerance for the outside diameter of an outer ring flange D1 is h9 (See ISO 286)

TABLE 5.4.3 EFFECTIVE WIDTH OF SUB-UNIT, TOLERANCE CLASS 4 (Normal Tolerance Class)

d		Δ *T1s*		Δ *T2s*	
Over	Including	High	Low	High	Low
Inch		Value in 0.0001 inch			
-	4	+40	0	+40	0
4	6	+60	-60	+80	-40
mm		Value in 0.001 mm			
-	101.6	+102	0	+102	0
(101.6)	152.4	+152	-152	+152	-102

5.5 Chamfer Dimensions Limits For Roller Bearings
(AS PER ISO : 582 / IS:5934)

Symbols



d = bearing bore diameter, nominal

D = bearing outside diameter, nominal

$r_{s\ min}$ = smallest permissible single chamfer dimension (minimum limit)

$r_{s\ max}$ = largest permissible single chamfer dimension (maximum limit)

$r_{as\ max}$ = largest permissible single shaft housing fillet radius

TABLE 5.5.1 TAPERED ROLLER BEARINGS

Dimensions in Millimetres

Cone (d) or Cup (D) back face chamfer				
	d or D		r_s max	
r_s min	>	<	radial direction	axial direction
0.3	- 40	40 -	0.7 0.9	1.4 1.6
0.6	- 40	40 -	1.1 1.3	1.7 2
1.0	- 50	50 -	1.6 1.9	2.5 3
1.5	- 120 250	120 250 -	2.3 2.8 3.5	3 3.5 4
2	- 120 250	120 250 -	2.8 3.5 4	4 4.5 5
2.5	- 120 250	120 250 -	3.5 4 4.5	5 5.5 6
3	- 120 250 400	120 250 400 -	4 4.5 5 5.5	5.5 6.5 7 7.5
4	- 120 250 400	120 250 400 -	5 5.5 6 6.5	7 7.5 8 8.5
5	- 180	180 -	6.5 7.5	8 9
6	- 180	180 -	7.5 9	10 11

TABLE 5.5.2 RADIAL BEARINGS EXCEPT TAPERED ROLLER BEARINGS

Dimensions in Millimetres

	d or D		r_s max	
r_s min	>	≤	radial direction	axial direction
0.3	- 40	40 -	0.6 0.8	1 1
0.6	- 40	40 -	1 1.3	2 2
1	- 50	50 -	1.5 1.9	3 3
1.1	- 120	120 -	2 2.5	3.5 4
1.5	- 120	120 -	2.3 3	4 5
2	- 80 220	80 220 -	3 3.5 3.8	4.5 5 6
2.1	- 280	280 -	4 4.5	6.5 7
2.5	- 100 280	100 280 -	3.8 4.5 5	6 6 7
3	- 280	280 -	5 5.5	8 8
4	-	-	6.5	9

TABLE 5.5.3 THRUST BEARINGS

Dimensions in Millimetres

r_s min	r_s max radial and axial direction
0.05	0.1
0.08	0.16
0.1	0.2
0.15	0.3
0.2	0.5
0.3	0.8
0.6	1.5
1	2.2
1.1	2.7
1.5	3.5
2	4
2.1	4.5
3	5.5
4	6.5
5	8
6	10

Comparison between nominal chamfer dimension & minimum chamfer limits

TABLE 5.5.4 RADIAL BEARINGS EXCEPT TAPERED ROLLER BEARINGS AND THRUST BEARINGS

Dimensions in Millimetres

r_s nom	r_s min
0.1	0.05
0.15	0.08
0.2	0.1
0.3	0.15
0.4	0.2
0.5	0.3
1	0.6
1.5	1
2	1.1*
2.5	1.5
3	2
3.5	2.1*
4	3
5	4
6	5
8	6
10	7.5
12	9.5
15	12
18	15
22	19

* In ISO :582-1972 the r_s min values were 1 and 2 mm respectively.

TABLE 5.5.5 TAPERED ROLLER BEARINGS

Dimensions in Millimetres

	Cup back face chamfer		Cup back face chamfer	
r nom	r_s min	r_s min (ISO 582-1972)	r_s min	r_s min* (ISO 582-1972)
0.5	0.3	0.3	0.3	0.3
1	0.6	0.6	0.6	0.6
1.5	1	1	1	1
2	1.5	1	1.5	1
2.5	2	1.5	1.5	1.5
3	2.5	2	2	2
3.5	3	2	2.5	2
4	4	3	3	3
5	5	4	4	4
6	6	5	5	5

5.6 Basic Tapered Bore, Taper 1:12

The normal taper angle (half the cone angle):

α = 2°23'9.4" = 2.385 94 =0.041 643 rad

The basic diameter at the theoretical large end of the bore :

d=d+1/12B

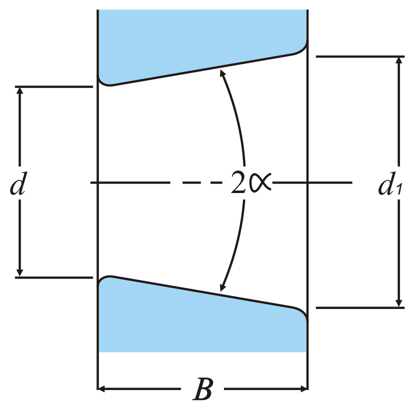
The tolerances for a tapered bore, taper 1 :12 comprise

a)a mean diameter tolerance, given by limits for the actual mean diameter deviation at the theoretical small end of the bore, Δdmp

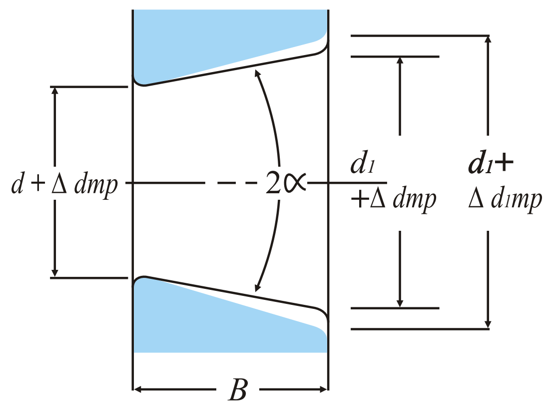
b)a taper tolerance diameter, given by limits for the difference between the actual mean diameter deviations at the two ends of the bore, Δd1mp- Δdmp; and

c)a tolerance for the diameter variation, Vdp' given by a maximum value applying in any radial plane of the bore

Normal Tolerance



Theoretical tapered hole



Tapered hole having dimensional difference of the average bore diameter within the flat surface

Unit μm

Table 5.6 Tolerance and allowable values (Class 0) of tapered hole of radial bearings

d (mm)		Δ dmp		Δ d1mp-Δ dmp		Vdp
Over	Including	High	Low	High	Low	Max.
	10	+22	0	+15	0	9
10	18	+27	0	+18	0	11
18	30	+33	0	+21	0	13
30	50	+39	0	+25	0	16
50	80	+46	0	+30	0	19
80	120	+54	0	+35	0	22
120	180	+63	0	+40	0	40
180	250	+72	0	+46	0	46
250	315	+81	0	+52	0	52
315	400	+89	0	+57	0	57
400	500	+97	0	+63	0	63
500	630	+110	0	+70	0	70
630	800	+125	0	+80	0	—
800	1,000	+140	0	+90	0	—
1,000	1,250	+165	0	+105	0	—
1,250	1,600	+195	0	+125	0	—

6. BEARING INTERNAL CLEARANCE

Bearing Internal clearance (Initial clearance) is the amount of internal clearances, a bearing has before being installed on a shaft or on a housing as shown in figure when either the inner/outer ring is fix and the other ring is free to move. Displacement can take place either in axial/radial direction. This amount of displacement (Radially or Axially) is termed by internal clearance, and depending on the direction, is called the radial clearance or the axial internal clearance. When the internal clearance of a bearing is measured, a slight measurement load is applied to the race ways so the internal clearance may be measured accurately. However, at this time, a slight amount of elastic deformation of the bearing occurs under the measurement load, and the clearance measurement value is slightly larger than the two clearances. This discrepancy between the two bearing clearances and the increased amount due to elastic deformation must be compensated. These compensated values are given in Table below

TABLE: 6.1 ADJUSTMENT OF RADIAL INTERNAL CLEARANCE OF DEEP GROOVE BALL BEARINGS BASED ON MEASURED LOAD

Unit µm

Nominal Bore Diameter d (mm)		Measuring Load		Radial Clearance Increase			
over	incl.	N	(Kgf)	C2	CN	C3	C4
10	18	24.5	(2.5)	3-4	4	4	4
18	50	49	(5)	4-5	5	6	6
50	200	147	(15)	6-8	8	9	9

Radial clearance of the bearing is built up for following reasons :

1. Accommodate the reduction of clearance in a bearing due to interference for inner ring on the shaft or outer ring in the housing.

2. Accommodate the minor changes in the dimensions of parts without affecting the bearing performance.

3. Compensate for the differential expansion of the two rings when the inner ring of a bearing operates at a higher temperature than the outer ring.

4. It allows a slight misalignment between the shaft and the housing, and thereby prevents the premature failure of the bearing

5. It affects the end play of radial ball bearing, and also affects their capacity for carrying axial loads, the greater the radial clearance the greater the capacity for supporting axial load.

IMPORTANT
Once ball and roller bearings are mounted and running, a small amount of radial internal or running clearance is normally desirable. In the case of bearings under radial load, quieter running is generally obtained when this clearance is minimum.

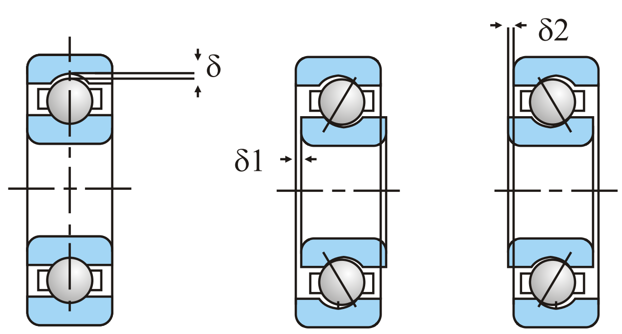
Radial bearings are made with following different ranges of radial internal clearance-C2, Normal, C3 and C4

C2 These bearings have the smallest amount of radial internal clearance. They should only be used where freedom from all shake is required in the assembled bearings and there is no possibility of the initial radial internal clearances being eliminated by external causes. Therefore, special attention must be given to the seating dimensions as the expansion of the inner ring or contraction of the outer ring may cause tight bearings. In this respect a C2 bearing should not be used unless recommended by us.

CN : This grade of radial internal clearance is intended for use where only one ring is made an interference fit, and there is no appreciable loss of clearance due to temperature difference. Ball and roller bearings for general engineering applications are usually of this clearance.

C3 : This grade of radial internal clearance should be used when both rings of a bearing are made an interference fit, or when only one ring is an interference fit but there is likely to be some loss of clearance due to temperature differences. It is the grade normally used for radial ball bearings that take axial loading but for some purposes even bearings with C4 clearance may be required.

C4 : Where there will be some loss of clearance due to temperature differences and both rings are interference fit, this grade of radial internal clearance is employed. One example of its use is in bearings for traction motors. Customers should always consult us before ordering bearings with this grade of radial internal clearance.



Radial Clearance = δ

Axial Clearance = $\delta 1 + \delta 2$

6.1 Internal Clearance Selection

The internal clearance of a bearing under operating conditions (effective clearance) is usually smaller than the same bearing's initial clearance before being installed and operated. This is due to several factors including bearing fit, the difference in temperature between the inner and outer rings, etc. As a bearing's operating clearance has an effect on bearing life, heat generation, vibration, noise, etc. ; care must be exercised in selecting the most suitable operating clearance.

Effective internal clearance :

The internal clearance differential between the initia! clearance and the operating (effective) clearance (the amount of clearance reduction caused by interference fits, or clearance variation due to the temperature difference between the inner and outer rings) can be calculated by the following formula :

$$\delta_{eff} = \delta_0 - (\delta_f + \delta_t)$$

where,

δ_{eff} = Effective internal clearance(mm)

δ_o = Bearing internal clearance (mm)

δ_f = Reduced amount of clearance due to interference (mm)

δ_t = Reduced amount of clearance due to temperature differential of inner and outer rings(mm)

Reduced clearance due to interference :

When bearings are installed with interference fits on shafts and in housings, the inner ring will expand and the outer ring will contract ; thus reducing the bearing's internal clearance. The amount of expansion or contraction varies depending on the shape of the bearing, the shape of the shaft or housing, dimensions of the respective parts, and the type of materials used. **The differential can range from approximately 70% to 90% of the effective interference.**

$$\delta_{ff} = (0.70 \sim 0.90)\ \Delta d_{eff}$$

where,

δ_f = Reduced amount of clearance due to interference (mm)

Δd_{eff} = Effective interference (mm)

Reduced internal clearance due to inner/outer ring temperature difference :

During operation, normally the outer ring will be from 5° to 10°C cooler than the inner ring or rotating parts. However, if the cooling effect of the housing is large, the shaft is connected to a heat source, or a heated substance is conducted through the hollow shaft, the temperature difference between the two rings can be even greater. **The amount of internal clearance is thus further reduced by the differential expansion of the two rings.**

$$\delta_t = \alpha . \Delta T . D_o$$

where,

δ_t=Amount of reduced clearance due to heat differential

α =Bearing steel linear expansion coefficient 12.5×10^{-6}/°C

ΔT=Inner/outer ring temperature differential (°C)

D_o=Outer ring raceway diameter (mm)

Outer ring raceway diameter, D Value can be calculated by using formula as given below:

For ball bearings and spherical roller bearings

$D_o = 0.20\,(d + 4D)$

For roller bearings (except self-aligning) $D_o = 0.25\,(d + 3D)$

where,

d = Bearing bore diameter (mm)

D = Bearing outside diameter (mm)

6.2 Radial Internal Clearance values as per ISO : 5753/IS:5935

6.2.1 Deep groove ball bearings

TABLE 6.2 RADIAL INTERNAL CLEARANCE FOR DEEP GROOVE BALL BEARINGS WITH CYLINDRICAL BORE

Clearance value in microns

Bore diameter *d* *(mm)*		Group 2 (C2)		Group N (CN)		Group 3 (C3)		Group 4 (C4)		Group 5 (C5)	
Over	Incl.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.
2.5	6	0	7	2	13	8	23	-	-	-	-
6	10	0	7	2	13	8	23	14	29	20	37
10	18	0	9	3	18	11	25	18	33	25	45
18	24	0	10	5	20	13	28	20	36	28	48
24	30	1	11	5	20	13	28	23	41	30	53
30	40	1	11	6	20	15	33	28	46	40	64
40	50	1	11	6	23	18	36	30	51	45	73
50	65	1	15	8	28	23	43	38	61	55	90
65	80	1	15	10	30	25	51	46	71	65	105
80	100	1	18	12	36	30	58	53	84	75	120
100	120	2	20	15	41	36	66	61	97	90	140
120	140	2	23	18	48	41	81	71	114	105	160
140	160	2	23	18	53	46	91	81	130	120	180
160	180	2	25	20	61	53	102	91	147	135	200
180	200	2	30	25	71	63	117	107	163	150	230
200	225	2	35	25	85	75	140	125	195	175	265
225	250	2	40	30	95	85	160	145	225	205	300
250	280	2	45	35	105	90	170	155	245	225	340
280	315	2	55	40	115	100	190	175	270	245	370
315	355	3	60	45	125	110	210	195	300	275	410
355	400	3	70	55	145	130	240	225	340	315	460
400	450	3	80	60	170	150	270	250	380	350	510
450	500	3	90	70	190	170	300	280	420	390	570
500	560	10	100	80	210	190	330	310	470	440	630
560	630	10	110	90	230	210	360	340	520	490	690
630	710	20	130	110	260	240	400	380	570	540	760
710	800	20	140	120	290	270	450	430	630	600	840
800	900	20	160	140	320	300	500	480	700	670	940
900	1000	20	170	150	350	330	550	530	770	740	1040
1000	1120	20	180	160	380	360	600	580	850	820	1150
1120	1250	20	190	170	410	390	650	630	920	890	1260

6.2.2 Cylindrical Roller Bearings

TABLE 6.3 RADIAL INTERNAL CLEARANCE OF CYLINDRICAL ROLLER BEARINGS (INTERCHANGEABLE)

Clearance value in microns

Bore diameter *d* *(mm)*		Group 2 (C2)		Group N (CN)		Group 3 (C3)		Group 4 (C4)		Group 5 (C5)	
Over	Incl.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.
-	10	0	25	20	45	35	60	50	75	-	-
10	24	0	25	20	45	35	60	50	75	65	90
24	30	0	25	20	45	35	60	50	75	70	95
30	40	5	30	25	50	45	70	60	85	80	105
40	50	5	35	30	60	50	80	70	100	95	125
50	65	10	40	40	70	60	90	80	110	110	140
65	80	10	45	40	75	65	100	90	125	130	165
80	100	15	50	50	85	75	110	105	140	155	190
100	120	15	55	50	90	85	125	125	165	180	220
120	140	15	60	60	105	100	145	145	190	200	245
140	160	20	70	70	120	115	165	165	215	225	275
160	180	25	75	75	125	120	170	170	220	250	300
180	200	35	90	90	145	140	195	195	250	275	330
200	225	45	105	105	165	160	220	220	280	305	365
225	250	45	110	110	175	170	235	235	300	330	395
250	280	55	125	125	195	190	260	260	330	370	440
280	315	55	130	130	205	200	275	275	350	410	485
315	355	65	145	145	225	225	305	305	385	455	535
355	400	100	190	190	280	280	370	370	460	510	600
400	450	110	210	210	310	310	410	410	510	565	665
450	500	110	220	220	330	330	440	440	550	625	735

TABLE 6.4 RADIAL INTERNAL CLEARANCE OF CYLINDRICAL ROLLER BEARINGS (NON-INTERCHANGEABLE)

Clearance value in microns

Nominal Bore diameter *d* (mm)		Bearing with cylindrical bore											
		C1NA		C2NA		NA[1]		C3NA		C4NA		C5NA	
Over	Incl.	Min	Max.	Min	Max.	Min	Max.	Min	Max.	Min	Max.	Min	Max.
-	10	5	10	10	20	20	30	35	45	45	55	-	-
10	18	5	10	10	20	20	30	35	45	45	55	65	75
18	24	5	10	10	20	20	30	35	45	45	55	65	75
24	30	5	10	10	25	25	35	40	50	50	60	70	80
30	40	5	12	12	25	25	40	45	55	55	70	80	95
40	50	5	15	15	30	30	45	50	65	65	80	95	110
50	65	5	15	15	35	35	50	55	75	75	90	110	130
65	80	10	20	20	40	40	60	70	90	90	110	130	150
80	100	10	25	25	45	45	70	80	105	105	125	155	180
100	120	10	25	25	50	50	80	95	120	120	145	180	205
120	140	15	30	30	60	60	90	105	135	135	160	200	230
140	160	15	35	35	65	65	100	115	150	150	180	225	260
160	180	15	35	35	75	75	110	125	165	165	200	250	285
180	200	20	40	40	80	80	120	140	180	180	220	275	315
200	225	20	45	45	90	90	135	155	200	200	240	305	350
225	250	25	50	50	100	100	150	170	215	215	265	330	380
250	280	25	55	55	110	110	165	185	240	240	295	370	420
280	315	30	60	60	120	120	180	205	265	265	325	410	470
315	355	30	65	65	135	135	200	225	295	295	360	455	520
355	400	35	75	75	150	150	225	255	330	330	405	510	585
400	450	45	85	85	170	170	255	285	370	370	455	565	650

[1] For bearings with normal clearance, only NA is added to bearing numbers, Ex. NU305NA

6.2.3 Double row self-aligning ball bearing

TABLE 6.5 DOUBLE ROW SELF ALIGNING BALL BEARINGS WITH CYLINDRICAL BORE

Clearance value in microns

Bore diameter *d* *(mm)*		Group 2 (C2)		Group N (CN)		Group 3 (C3)		Group 4 (C4)		Group 5 (C5)	
Over	Incl.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.
2.5	6	1	8	5	15	10	20	15	25	21	33
6	10	2	9	6	17	12	25	19	33	27	42
10	14	2	10	6	19	13	26	21	35	30	48
14	18	3	12	8	21	15	28	23	37	32	50
18	24	4	14	10	23	17	30	25	39	34	52
24	30	5	16	11	24	19	35	29	46	40	58
30	40	6	18	13	29	23	40	34	53	46	66
40	50	6	19	14	31	25	44	37	57	50	71
50	65	7	21	16	36	30	50	45	69	62	88
65	80	8	24	18	40	35	60	54	83	76	108
80	100	9	27	22	48	42	70	64	96	89	124
100	120	10	31	25	56	50	83	75	114	105	145
120	140	10	38	30	68	60	100	90	135	125	175
140	160	15	44	35	80	70	120	110	161	150	210

TABLE 6.6 DOUBLE ROW SELF ALIGNING BALL BEARINGS WITH TAPERED BORE

Clearance value in microns

Bore diameter *d* *(mm)*		Group 2 (C2)		Group N (CN)		Group 3 (C3)		Group 4 (C4)		Group 5 (C5)	
Over	Incl.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.
18	24	7	17	13	26	20	33	28	42	37	55
24	30	9	20	15	28	23	39	33	50	44	62
30	40	12	24	19	35	29	46	40	59	52	72
40	50	14	27	22	39	33	52	45	65	58	79
50	65	18	32	27	47	41	61	56	80	73	99
65	80	23	39	35	57	50	75	69	98	91	123
80	100	29	47	42	68	62	90	84	116	109	144
100	120	35	56	50	81	75	108	100	139	130	170
120	140	40	68	60	98	90	130	120	165	155	205
140	160	45	74	65	110	100	150	140	191	180	240

6.2.4 Double row self-aligning roller bearing

TABLE 6.7 DOUBLE ROW SPHERICAL ROLLER BEARINGS WITH CYLINDRICAL BORE

Clearance value in microns

Bore diameter *d* *(mm)*		Group 2 (C2)		Group N (CN)		Group 3 (C3)		Group 4 (C4)		Group 5 (C5)	
Over	Incl.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.
14	18	10	20	20	35	35	45	45	60	60	75
18	24	10	20	20	35	35	45	45	60	60	75
24	30	15	25	25	40	40	55	55	75	75	95
30	40	15	30	30	45	45	60	60	80	80	100
40	50	20	35	35	55	55	75	75	100	100	125
50	65	20	40	40	65	65	90	90	120	120	150
65	80	30	50	50	80	80	110	110	145	145	180
80	100	35	60	60	100	100	135	135	180	180	225
100	120	40	75	75	120	120	160	160	210	210	260
120	140	50	95	95	145	145	190	190	240	240	300
140	160	60	110	110	170	170	220	220	280	280	350
160	180	65	120	120	180	180	240	240	310	310	390
180	200	70	130	130	200	200	260	260	340	340	430
200	225	80	140	140	220	220	290	290	380	380	470
225	250	90	150	150	240	240	320	320	420	420	520
250	280	100	170	170	260	260	350	350	460	460	570
280	315	110	190	190	280	280	370	370	500	500	630
315	355	120	200	200	310	310	410	410	550	550	690
355	400	130	220	220	340	340	450	450	600	600	750
400	450	140	240	240	370	370	500	500	660	660	820
450	500	140	260	260	410	410	550	550	720	720	900
500	560	150	280	280	440	440	600	600	780	780	1000
560	630	170	310	310	480	480	650	650	850	850	1100
630	710	190	350	350	530	530	700	700	920	920	1190
710	800	210	390	390	580	580	770	770	1010	1010	1300
800	900	230	430	430	650	650	860	860	1120	1120	1440
900	1000	260	480	480	710	710	930	930	1220	1220	1570

TABLE 6.8 DOUBLE ROW SPHERICAL ROLLER BEARINGS WITH TAPERED BORE

Clearance value in microns

Bore diameter *d* *(mm)*		Group 2 (C2)		Group N (CN)		Group 3 (C3)		Group 4 (C4)		Group 5 (C5)	
Over	Incl.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.
18	24	15	25	25	35	35	45	45	60	60	75
24	30	20	30	30	40	40	55	55	75	75	95
30	40	25	35	35	50	50	65	65	85	85	105
40	50	30	45	45	60	60	80	80	100	100	130
50	65	40	55	55	75	75	95	95	120	120	160
65	80	50	70	70	95	95	120	120	150	150	200
80	100	55	80	80	110	110	140	140	180	180	230
100	120	65	100	100	135	135	170	170	220	220	280
120	140	80	120	120	160	160	200	200	260	260	330
140	160	90	130	130	180	180	230	230	300	300	380
160	180	100	140	140	200	200	260	260	340	340	430
180	200	110	160	160	220	220	290	290	370	370	470
200	225	120	180	180	250	250	320	320	410	410	520
225	250	140	200	200	270	270	350	350	450	450	570
250	280	150	220	220	300	300	390	390	490	490	620
280	315	170	240	240	330	330	430	430	540	540	680
315	355	190	270	270	360	360	470	470	590	590	740
355	400	210	300	300	400	400	520	520	650	650	820
400	450	230	330	330	450	450	570	570	720	720	910
450	500	260	270	270	490	490	630	630	790	790	1000
500	560	290	410	410	540	540	680	680	870	870	1100
560	630	320	460	460	600	600	760	760	980	980	1230
630	710	350	510	510	670	670	850	850	1090	1090	1360
710	800	390	370	370	750	750	960	960	1220	1220	1500
800	900	440	640	640	840	840	1070	1070	1370	1370	1690
900	1000	490	710	710	930	930	1190	1190	1520	1520	1860

7. LUBRICATION

Why Bearing Should be lubricated ?

Lubrication is an essential requirement for the proper operation of bearings.
The purpose of bearing lubrication is to prevent direct metallic contact between the various rolling and sliding elements. This is accomplished through the formation of a thin film of oil/grease on the contact surfaces.

The Advantages of lubrication

* Protects the bearing from rust & corrosion.
* Protects the bearing from the foreign particles.
* Minimizes the friction between the races & rolling elements.
* Reduces the friction arising out of elastic deformation of rolling elements when under load.
* Facilitates the smooth running of bearing by minimizing noise.
* Dissipates the heat from the bearing and helps to distribute the frictional heat uniformly throughout the bearing, which gets generated during operation.
* Saves power losses by minimizing internal friction.
* Helps the bearing to attain the required speed.
* Helps to attain the anticipated life of the bearing.

Selection of lubricant:

* Small size bearings operating at high speed, low viscosity oil is used
* Large bearing carrying heavy load, lubricants with higher viscosity and additional additive properties may be used.
* The lubricant must have sufficient lubricating capacity at the prevailing temperature
* It must form a load sustaining lubricating film for prevailing load conditions.
* It must have the capacity to absorb water to a certain extent, without affecting the lubricating capacity wherever the application demands.

When the Lubricant quality and quantity is inadequate, it results in the cage failure, inadequate lubrication may heat up cage and may break down the ball pockets. Due to break down of the lubricating films on raceways and rolling element surfaces it may develop scoring marks, which lead to premature failure of the bearing.
This condition may also result In the deformation of parts and when the bearing deformed parts rotate under load, sliding motion will take place instead of rolling motion and it ends up in premature bearing failure.

Table 7.1 Lubrication methods and characteristics

Method	Grease Lubrication	Oil Lubrication
Handling	□	△
Reliability	o	□
Cooling Effect	x	o
Seal Structure	o	△
Power loss	o	o
Environment Contamination	o	△
High speed rotation	x	o

□ : Very Good   o : Good   △ : Fair   x : Poor

7.1 Types of Lubrication

7.1.1 Grease Lubrication

Grease type lubricants are relatively easy to handle & require only the simplest sealing devices and it also involves a minimum of design and maintenance requirements and thus offers an optimum economy. For these reasons, grease is most widely used lubricant for rolling bearings.
Grease is a semi-solid lubricant consisting of base oil, thickener and additives

A. Base Oil :

Mineral oils or synthetic oils such as silicon diester oils and fluorocarbon oils are mainly used as the base oil for grease. The lubricating properties of grease depend mainly on characteristics of its base oil. Therefore greases with low viscosity base oil are best suited for low temperature and high speeds. High viscosity base oils are best suited for heavy loads.

B. Thickening Agents :

Thickening agents are compounded with the base oils to maintain the semi-solid state of the grease. There are several types of metallic soaps such as lithium, sodium & calcium and inorganic thickeners such as silica gel & bentonite and heat resisting organic thickeners such as polyurea and fluoric compounds.
The various special characteristics of a grease, such as limiting temperature range, mechanical stability, water resistance, etc. depend largely on the type of thickening agent used. For example, a sodium based grease is generally poor in water resistance and lithium base greases are water repellent within the certain limits and may also be used in the case of moisture if corrosion inhibitors are added. Greases with betone, poly-urea and other non-metallic soaps as the thickening agent are generally superior in high temperature properties.

C. Additives :

Various additives are added to grease such as antioxidants, corrosion inhibitors and extreme pressure additives (EP Additives) to improve various properties.
EP additives are used in heavy load applications. For long use without replenishment, an antioxidant should be added.

D. Consistency:

Consistency indicate the stiffness and liquidity and expressed by a numerical index.
Greases are divided into various consistency classes according to the NLGI (National Lubricating grease Institute Scale). The NLGI values for this index indicate the relative softness of the grease, the larger the number the stiffer the grease. It is mainly determined by the amount of thickening agent used and the viscosity of the base oil. For rolling bearing lubrication grease with the NLGI numbers of 1 ,2, & 3 are used.

TABLE 7.2 RELATIONSHIP BETWEEN CONSISTENCY AND APPLICATION OF GREASE

NLGI Consistency No.	Worked Penetration	Working conditions
0	355~385	• For centralised greasing use • When fretting is likely to occur
1	310~340	• For centralised greasing use • When fretting is likely to occur • For low temperature
2	265~295	• For general use • For selected ball bearings • For high temperature
3	220~250	• For general use • For selected ball bearings
4	175~205	• For high temperature • For special use

TABLE 7.3 CRITERIA FOR SUITABLE GREASE SELECTION

Working condition	Suitable Grease
• For smooth running (Low noise level)	• Grease of penetration class 2
• Vertical Mounting	• Grease with good adhesion properties of classes 3 & 4
• If outer ring rotation or centrifugal force on bearing	• Grease having additional quantity of thickener of class 2 to 4
• High Temperature	• Grease with Synthetic base oil and class of 3 & 4
• Low Temperature	• Low viscosity grease with suitable oil of class 1 & 2.
• Contaminated Environment	• Grease of class 3

For further detail you may contact our Technical Cell

E. Mixing Different Types of grease

In general, different brands and different kinds of grease must not be mixed because of the different additives they contain. Mixing grease with different types of thickeners may impair its composition and physical properties. However, if different greases must be mixed, at least greases with the same base oil and thickening agent should be selected. But even when the grease of the same base oil and thickening agent are mixed, the quality of the grease may still change due to difference in their additives.

Amount of Grease

The amount of grease used in any given situation will depend on the following factors :
(1) Size & Shape of housing, (2) Space limitation, (3) Bearing's speed, (4) Operating Load, (5) Type of grease
(6) Operating Conditions

As a general rule housing & bearing should be only filled with 30% to 60% of their capacities. Where speeds are high and temperature rise, needs to be kept to a minimum, reduced amount of grease should be used.
Excessive amount of grease causes temperature rise which in turn causes the grease to soften and may allow leakage.
If excessive grease is used, oxidation and deterioration may cause lower lubricating efficiency.
Moreover the standard bearing space can be found by following formula,

V = K. W.
Where
V : Quantity of bearing space open type (Cm^3)
K : Bearing Space Factor
W : Mass of Bearing in Kg.
(Specific gravity of grease = 0.9)

TABLE 7.4 BEARING SPACE RATIO (K)

Bearing Type	Retainer Type	K
Ball Bearings ❶	Pressed Retainer	61
NU-cylindrical Roller Bearings ❷	Pressed Retainer Machined Retainer	50 36
N-cylindrical Roller Bearings ❸	Pressed Retainer Machined Retainer	55 37
Tapered Roller Bearings	Machined Retainer	46
Spherical Roller Bearings	Pressed Retainer Machined Retainer	35 28

●Remove 160 Series ● Remove NU4 Series ● Remove N4 Series

In general, the permissible working temperature is limited by the degree of mechanical agitation to which the grease is subjected, and we shall be pleased to recommend suitable lubricants for varying conditions on receipt of necessary particulars

Before the bearings are set to work, they should be thoroughly charged with grease in such a manner as to ensure the efficient coating of all working surfaces. The housing should also be lightly packed with grease, it being important that a reserve supply of lubricant should be maintained in actual contact with the bearing to promote satisfactory and continuous lubrication. Over filling or cramming should, however, be avoided, for excessive greasing may cause overheating due to churning, and if two bearings are mounted in the same housing, they, for this reason, should be separated by distance pieces. If correctly applied, one charge of grease will last for a very long period, varying with the condition of working.

Grease Relubrication

Grease replenishment or exchange is required if the grease service life is shorter than the anticipated bearing life.
The bearings are re-lubricated by means of grease guns through lubricating nipples. If frequent re-lubrication is required, grease pumps and volumetric metering units must be used.
It is essential that the fresh grease displace the spent grease, so that the grease get exchanged, but overgreasing is prevented.
Grease Relubrication Quantities
Relubrication quantity L_1 for weekly to yearly re-lubricating
L1 = D.B.X (in grams)
D = Outer dia of the bearing (mm)
B = Width of the bearing (mm)

		X
Weekly	:	0.0020
Fortnightly	:	0.0025
Monthly	:	0.0030
Yearly	:	0.004-0.005

Grease replenishment intervals can also be calculated by using following graph.
This chart indicates the replenishment interval for standard rolling bearing grease when used under normal operating conditions.
As operating temperature increases, the grease re-supply interval should be shortened accordingly.
Generally, for every 10°C increase in bearing temperature, above 80°C, the lubrication period is reduced by exponent "1/1.5".

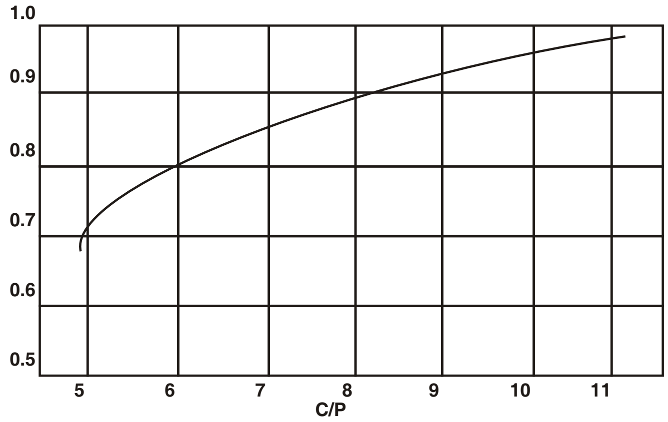
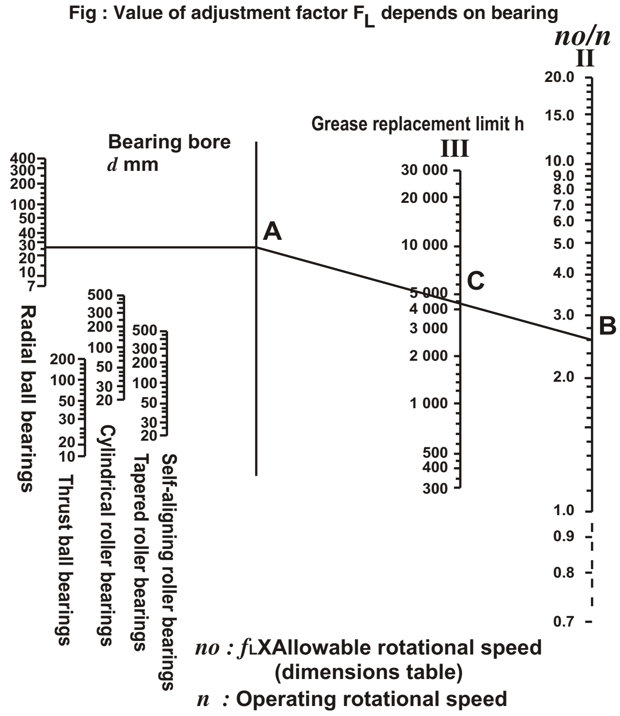


Fig : Value of adjustment factor F_L depends on bearing



Example : Find the grease lubrication interval for ball bearing 6205 with a radial load 1 .4 kN operating at 4800 r/min

Cr/Pr = 14/1 .4 kN = 10 from fig. 2 adjusted load fL is 0.98

From the bearing tables the allowable speed for bearing 6205 is 13000 r/min & numbers of revolutions at a radial load of 1.4 kN are
n_o = 0.98x13000 = 12740 r/min
therefore n/n_o = 12740/4800 = 2.6
Using the chart in fig.3 locate the point corresponding to bore diameter d=25 mm on the vertical line for radial ball bearings. Draw a straight- horizontal line to vertical line I. After that draw a straight-line from that point (A in example) to a point on the line II which corresponds to the n_O/n value (2.6 in example). Point C, where this line intersects vertical line indicates the lubrication interval 'h' which is approximately 4500 hours.

TABLE 7.5 GREASE VARIETIES AND CHARACTERISTICS :

Grease name	Lithium grease			Calcium grease (cup grease)	Sodium grease (fiber grease)
Thickener	Lithium Soap			Calcium Soap	Sodium Soap
Base Oil	Mineral oil	Synthetic oil (diester oil)	Synthetic oil (Silicon oil)	Mineral oil	Mineral oil
Dropping point (°c)	170 to 190	170 to 230	220 to 260	80 to 100	160 to 180
Operating temp. Range (°c)	-30 to +120	-50 to +130	-50 to +180	-10 to +70	0 to +110
Rotational range	Medium to high	High	Low to medium	Low to medium	Low to high
Mechanical stability	Excellent	Good to excellent	Good	Fair to good	Good to excellent
Water resistance	Good	Good	Good	Good	Bad
Pressure resistance	Good	Fair	Bad to fair	Fair	Good to excellent
Remarks	Most widely usable for various rolling bearings	Superior Low, Temperature & friction characteristics. Suitable for bearings for measuring instruments & extra small ball bearings for small electric motors.	Superior, High & low temperature characteristics.	Suitable for application at Low rotation speed & under light load. Not applicable at high temperature	Liable to emulsify in the presence of water. Used at relatively high temperature.

Grease name	Complex Base Grease		Non-Soap Base Grease		
Thickener	Lithium Complex Soap	Calcium Complex Soap	Bentone	Urea Compounds	Fluorine Compunds
Base Oil Dropping point (C)	Mineral Oil 250 or Higher	Mineral Oil 200 to 280	Mineral Oil -	Mineral Oil/Synthetic Oil 240 or higher	Synthetic Oil 250 or Higher
Operating Temp. Range (C)	-30 to +150	-10 to +130	-10 to +150	-30 to +150	-40 to +250
Rotational Range	Low to High	Low to Medium	Medium to High	Low to High	Low to Medium
Mechanical Stability	Good to Excellent	Good	Good	Good to Excellent	Good
Water Resistance	Good to Excellent	Good	Good	Good to Excellent	Good
Pressure Resistance	Good	Good	Good	Good to Excellent	Good
Remarks	Superior mechanical stability and heat resistance. Used at relatively high temperature.	Superior pressure resistance when extreme pressure agents is added. Used In bearings for rolling mills.	Suitable for application at high temperature & under relatively heavy load	Superior water resistance, oxidation stability, and heat stability. Suitable for application at high temperature & high rotation speed.	Superior chemical resistance and solvent resistance. Usable upto 250 °C.

7.1.2 OIL LUBRICATION :

- Oil lubrication is considered to be more effective than grease, provided proper sealing methods are employed to prevent the leakage.
- Only highly refined oil should be used as bearing lubricant.

OIL IS PREFERRED - WHERE

- Bearing speed is high
- Operating temperature is considerably high
- Dirt conditions are minimum
- Sealing methods can be easily employed

TYPES OF OILS

- Natural oil
- Synthetic oil
  a) Diesters b) Silicon oil c) Fluorinated oil
  d) Polyglycols e) Synthetic hydrocarbons
- Animal & Vegetable oils

TABLE 7.6 CHARACTERISTICS OF LUBRICATING OILS

TYPE OF LUBRICATING OIL	HIGHLY REFINED MINERAL OIL	MAJOR SYNTHETIC OILS				
		DIESTER OIL	SILICON OIL	POLYGLYCOLIC OIL	POLYPHENYL ETHER OIL	FLOURINATED OIL
Operating Temp. range (C°)	-40 to +150	-55 to +150	-70 to +350	-30 to +150	0 to +330	-20 to +300
Lubricity	Excellent	Excellent	Fair	Good	Good	Excellent
Oxidation stability	Good	Good	Fair	Fair	Excellent	Excellent
Radioactivity resistance	Bad	Bad	Bad to Fair	Bad	Excellent	---------
Suitability for High Loads	Very Good	Good	Poor	Very Good	Very Good	Good

With regard to operating temperature & lubrication, the following table lists the required oil visocisty for different types of rolling bearings.

Bearing Type	Dynamic Viscosity (mm²/s)
Ball bearings, Cylindrical roller bearings, Needle roller bearings	13
Spherical roller bearings, Tapered roller bearings, Needle roller thrust bearing	20
Self-Aligning roller thrust bearings	30

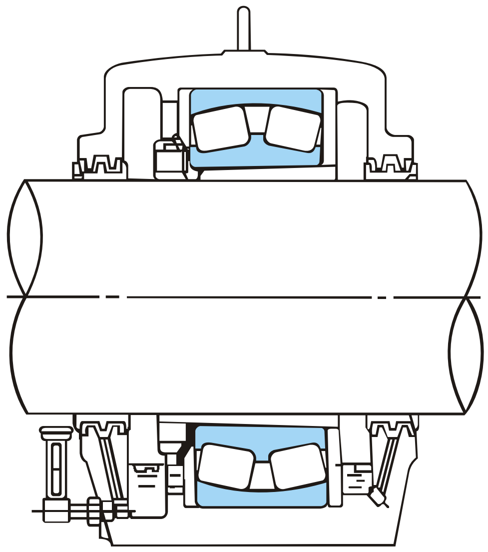
Remarks : 1mm²/s = 1 cSt (Centistokes)

Amount of oil : When oil bath lubrication is used and a bearing mounted with its axis horizontal, oil should be added until the static oil level is at the center of the lowest bearing rolling element. For vertical shaft, add oil to cover 50% to 80% of the rolling element.

7.2 Methods of Oil Lubrication

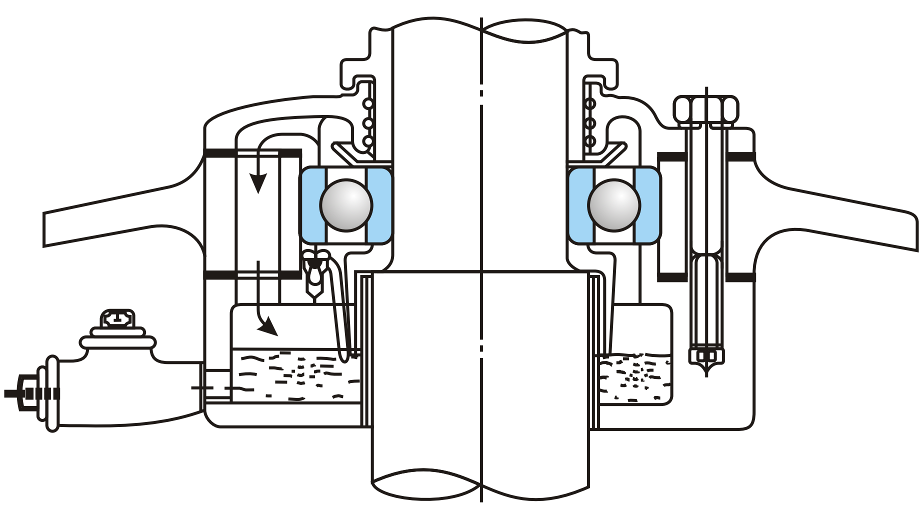
7.2.1 Oil bath lubrication

This method of lubrication is one of the most popular for slow and intermediate speed operation. This is referred to as "oil bath lubrication", because the bearing operates in an oil bath made by filling the housing with oil. Too much oil causes excessive temperature rise (through agitation) while too little oil may cause seizing. To assure proper lubrication it is sufficient that the oil level be kept around the center of bottom balls/ rollers of bearing in stationary condition. In the case of horizontal shaft, this level is determined when the bearing is idle. It is desirable to install an oil gauge so that the oil level can easily be checked when the bearing is idle. In the case of a vertical shaft, 50-80% of the ball / roller should be submerged when the bearing is idle. When more than two bearings are connected to a hosing, the bearing running at the bottom will generate heat unless it rotates at extremely low speed. For such cases, we recommend the use of some other lubrication method.



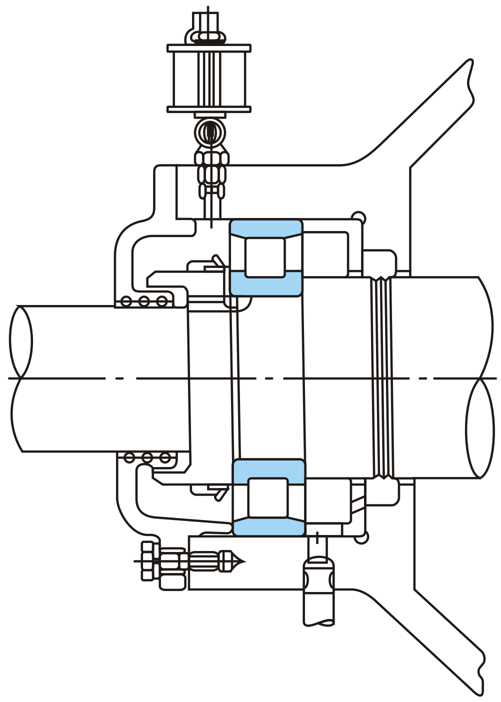
7.2.2 Splash lubrication

This is a lubrication method where, without direct submersion, oil is splashed by impellers attached to a shaft. This method is effective for fairly high speeds. One example, where splash lubrication is commonly used for bearings and gears is in a gear box where the gears may also be the splashing devices. In this case however, a shield plate should be installed or a magnet should be placed at the bottom of both to prevent worn grindings from the gears from possibly entering the bearings. Use of a conical rotating element in lieu of an impeller on a vertical shaft is effective in splashing oil, supplied by centrifugal force.



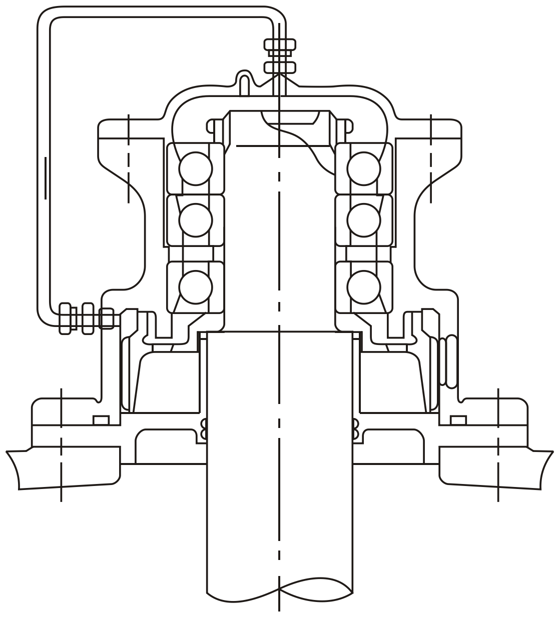
7.2.3 Drop-Feed lubrication

This is a lubrication method where an oil pot or oil reservoir (usually called an "oiler") is installed at the upper portion of housing and oil drips from the oiler through a tiny hole of from a wick (through capillary action). The dripping oil is converted to fog or mist on collisions with the rotating shaft / bearing parts. This method is more effective for comparatively high speeds and light loads rather than medium loads. Although application capability is great irrespective of shaft mounting (vertical or horizontal) remember to top off the oiler before it runs dry..



7.2.4 Circulating lubrication

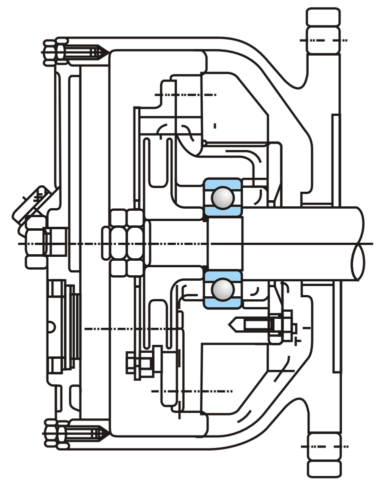
- Used for bearing cooling applications or for automatic oil supply systems in which the oil supply is centrally located.
- One of the advantages of this method is that oil cooling devices and filters to maintain oil purity can be installed within the system.
- In order for oil to throughly lubricate the bearing, oil inlets and outlets must be provided on opposite sides of the bearing.



.

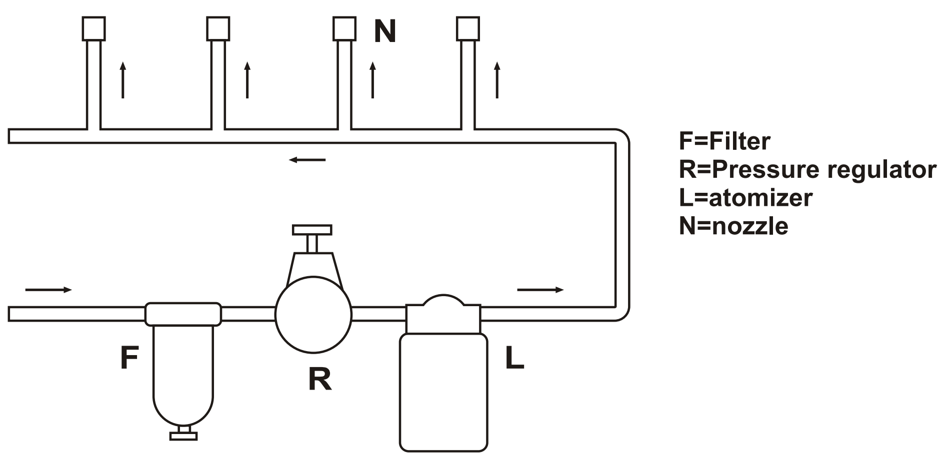
7.2.5 Disc Lubrication

- In this method, a partially submerged disc rotates and pulls oil up into a reservoir from which it then drains down through the bearing, lubricating it.



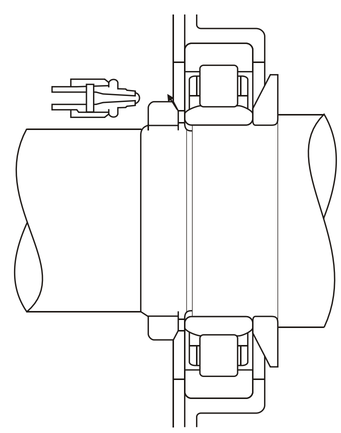
7.2.6 Spray lubrication (oil-mist lubrication)

Filtered oil is blown through a lubrication sprayer (using dry compressed air), emerging in an atomized form and is fed into the housing for lubrication. This lubrication method is called "spray lubrication" or "oil-mist lubrication", which features low resistance of oil, high effectiveness of cooling and prevention of bearings from dust or water invasion due to high internal pressure associated with new oil feeding at all times. This method has often been used for bearings with comparatively light loads such as high speed main spindle bearings or grinding machines though it recently has become popular for bearings mounted on metal rolling mills. In cases of metal rolling mills, oil atomizing by heating high viscosity oil causes the bearing to raise its temperature. Therefore, care should be taken when selecting the bearing clearance. Because of continuous clean bearing operation and less risk of oil leakage, use of this lubrication method is expanding.



7.2.7 Oil Jet lubrication

- This method lubricates by injecting oil under high pressure directly into the side of the bearing. This is a reliable system for high speed, high temperature or otherwise severe conditions.
- Used for lubricating the bearings in jet engines, gas turbines and other high speed equipment.
- Under-race lubrication for machine tools is one example of this type of lubrication



8. SEATINGS, LIMITS AND FITS

8.1 Seatings

Seatings for bearing rings must be parallel, circular and machined to their correct limits. Badly made seatings can distort thin section bearing rings, and thus reduce the efficiency and life of the bearings.

Shafts must be designed so that where rigid bearings are used, the slope at the bearings due to deflection is as small as possible. The permissible slope must vary with individual applications as it depends upon the operating conditions consequently limiting values are not listed. When experience is lacking on this point, our Technical Department will be pleased to give advice.

Housing must give adequate support to the outer ring of a bearing under load. If a housing distorts excessively, the outer ring will invariably distort as well, causing premature failure of the bearing. Where individual housing is used accurate alignment must be provided for rigid bearings.

Split housing should not be used unless absolutely necessary, since the joint between the cap and its base could distort the outer ring. If such housings are used, the two halves should be accurately doweled or registered before the bearing seating is machined. It is advisable to ensure that the cap can only be fitted one way round by suitably arranging the dowels or register.

Light alloy housings should be provided with substantial steel liners when :

- A bearing has to work under wide variation of temperature, as differential expansion between the seating and bearing materials affects the initial fit between these members.
- Heavy and/or shock loads are involved, for alloy seatings can quickly loose shape under such loading and give rise to serious trouble.
- The steel liners must be an interference fit in their housings at the temperature extremes anticipated, and beating seatings should be machined after the liners are fitted.
- When light alloy or other non ferrous seating are to be used, we advise consultation with our Technical Department about the seating limits to be adopted.

Seating Fits

It is very important that bearing seatings be machined to their correct limits, incorrect fits can cause tightness within the bearing or allow one or both of the bearing rings to creep, and affect the running accuracy and the assembly and disassembly of a machine.

Creep is slow rotation of one ring relative to its seating. It is undesirable since the shaft and the bore of the bearing or the housing and the outside diameter of the bearing become worn. Creep is not due to friction within a bearing but is generally caused by radial loads rotating or oscillating with respect to a fixed point on the ring under consideration. The only satisfactory way of preventing creep under such conditions is to make the affected ring an interference fit on its seating. Set-screws or key ways should not be used in an effort to prevent creep, for they quickly wear due to constant chafing, or can distort bearing- rings, causing local overload and rapid bearing failure. Also, clamping a ring endways does not normally prevent creep.

Ball Journal, Roller Journal, Angular Contact and Duplex Bearings

Rotating Rings (usually inner ring) should be made interference fit on their seating to ensure that they will not creep.

Stationary Rings (usually outer ring) need not be interference fit provided there are no out-of-balance or oscillating loads.

Some bearing rings must slide endways on their seatings and in such cases a sliding fit is essential, although excessive slackness should be avoided. For example, where two or more Ball Journal bearings, or Roller Journal bearings with non detachable rings are mounted on the same unit, the unlocated ring or rings should be free to move endways, otherwise the bearings that are adjusted endwise should also be made sliding fits. Where the stationary ring of Ball Journal, Angular Contact or Duplex Bearing is held endways, it is common practice to make the ring a sliding fit. In the case of Roller Journal bearings a transition fit is normally used. For Journal bearings light interference fits, however, are not detrimental provided the correct diametral clearance is used, and the seating fit adopted may well be governed by considerations of mounting, dismounting, and of rigidity.

If a stationary ring does creep, out-of-balance loading or out-of square mounting of one of the bearing rings must be suspected. Mounting errors should be corrected, and where out-of-balance loading exists the assembly should be dynamically balanced, static balancing not being enough. Where out-of balance loading can't be reduced to a low level, or where it is a function of the machine, an interference fit must be used on the stationary ring as well as on the rotating ring. In a bearing arrangement where interference fits are used on all rings, a bearing layout must be used in which there is no danger of the bearings being axially nipped one against the other.

8.2 Fits

The necessity of a proper fit

In some cases improper fit may lead to damage and shorten bearing life. Therefore, it is necessary to make a careful analysis while selecting a proper fit.

Some of the negative conditions caused by improper fit are listed below :

- Raceway cracking, early pitting and displacement of raceways
- Raceway & shaft or housing abrasion caused by creeping in fretting corrosion
- Seizing caused by loss of internal clearance
- Increased noise & lowered rotational accuracy due to raceway groove deformation.

Selection of fits

Selection of proper fit depended upon thorough analysis of bearing operating conditions, including consideration of following factors :

(1) Condition of Rotation

Condition of rotation refer to the moving of bearing ring being considered in relation to the direction of load. There are 3 different conditions :

- Rotating load
- Stationery load
- Direction of load indeterminate

(2) Magnitude of the load

The interference fit of a bearing's Inner ring on its seating will be loosened with the increasing load, as the ring will expand under the influence of rotating load, & ring may begin to creep. So, if it is of shock character, greater interference is required.

The loss of interference due to increasing load can be estimated using the following equation :

When Fr is $\leq 0.3C_{or}$

$$\Delta dp = 0.08\sqrt{\frac{d \; Fr}{B}}$$

When Fr is $\leq 0.3\,C_{or}$

$$\Delta dp = 0.02\left(\frac{Fr}{B}\right)$$

Where Δdp = Interference decrease of inner ring(μm)
d = Bearing Bore (mm)
B = Inner Ring Width(mm)
Fr = Radial Load (N)
C_{or} = Basic Static Load (N)

(3) Bearing Internal Clearance

- An interference fit of a bearing on the shaft or in housing means that ring is elastically deformed (expanded or compressed), and bearing's internal clearance reduced.
- The internal clearance and permissible reduction depend on the type and size of the bearing.
- The reduction in clearance due to interference fit can be so large that bearings with an internal clearance which is greater than normal have to be used.
- The expansion of the inner ring and contraction of outer ring can be assumed to be approximately 60 - 80 % of the interference, depending on the material of shaft and housing.

(4) Temperature Condition

Interference between inner ring & steel shaft is reduced as a result of temperature increase (difference between bearing temperature and ambient temperature). This can result in an easing of fit of the inner ring on its seating. while outer ring expansion may result in increase in clearance.

The decrease of the interference of the inner ring due to this temperature difference may be calculated using following equation :

$$\Delta dt = 0.0015 \; d \; \Delta T$$

Where Δdt = Required effective interference for temperature difference μm
ΔT = Temperature difference between bearing temperature and ambient temperature °c.
d = Bearing bore diameter mm.

(5) Running Accuracy Requirement

To reduce resilience and vibration, clearance fit should generally not be used for bearings, where high demands are placed on running accuracy.

(6) Design & Material of Shaft & Housing

The fit of a bearing ring on its seating must not lead to uneven distortion of the ring (out of roundness). This can be caused by discontinuity in the housing surface. Split housings are therefore not suitable where outer rings are to have an interference fit.

(7) Ease of Mounting & Dismounting

Bearings with clearance fit are usually easier to mount or dismount than those having interference fit. Where operating condition necessitate interference fit and it is essential that mounting & dismounting can be done easily, separable bearings or bearings with taper bore and adaptor or withdrawal sleeve may be used.

(8) Displacement of Non-Locating Bearings

If non-separable bearings are used as floating bearings, it is imperative that one of the bearing rings has to move axially during operation. This is ensured by adopting a clearance fit for that ring, which carries a stationary load, when the outer ring is under stationary load, so that axial displacement has to take place in the housing bore, a hardened intermediate bushing is often fitted to the outer ring.

(9) Effective Interference and finish of shaft & housing

Since the roughness of the fitted surface is reduced during fitting, the effective interference becomes less than the apparent interference. the amount of this interference decrease varies depending on roughness of the surfaces.

Normally, manufacturers assume the following interference reductions :

For ground shaft : 1 Micron to 2.5 Micron
Machined Shaft : 5 Micron to 7 Micron

(10) Fitting Stress & Ring Expansion and Contraction

While calculating the minimum required amount of interference, following factors should be taken into consideration :

- Interference is reduced by radial load
- Interference is reduced by difference between bearing temperature and ambient temperature
- Interference is reduced by variation of fitted surfaces

Important Details on Fits

- Maximum interference should not exceed the ratio of 1 : 1000 of shaft or outside diameter.

- Tight interference fits are recommended for :
  (a) Operating conditions with large vibrations or shock loads
  (b) Application using hollow shaft of housing with thin walls
  (c) Application using housing made of light alloys or plastic.

Loose interferences are recommended for :
(a) Application requiring high running accuracy
(b) Application using small size bearings or thin walled bearings.

Shaft and housing material, geometry, hardness and surface finish must be carefully controlled. Ground shafts should be finished to 1 .3 micron Ra or better ; for turned shafts, a finish of 2.5 micron Ra or better ; and housing bores should be finished to 4 micron Ra or better.

To avoid shearing of aluminium and magnesium housing during bearing installation, steel inserts should be used ; alternatively special lubricants may be used for freezing and heating to facilitate assembly. A minimum interference fit of 0.0015" and 0.001" per inch of diameter is required for magnesium and aluminium housing respectively.

Where bearings are to be pressed onto a hollow shaft, allowance must be made for contraction of the hollow shaft in order to maintain the desired radial pressure.

THE NEI PRODUCT ENGINEERING DEPARTMENT SHOULD BE CONSULTED FOR PROPER FITTING PRACTICE ON ALL SPECIAL APPLICATIONS.

Numeric value table of fitting for radial bearing of 0 class (Normal class) for metric size

TABLE 8.1 FITTING AGAINST SHAFT

Unit μm

Nominal bore diameter of bearing d (mm) Over	Incl.	Δdmp high	low	g_5	g_6	h_5	h_6	j_5	js_5	j_6
3	6	0	-8	4T - 9L	4T - 12L	8T - 5L	8T - 8L	11T - 2L	10.5T - 2.5L	14T - 2L
6	10	0	-8	3T - 11L	3T - 14L	8T - 9L	8T - 9L	12T - 2L	11T - 3L	15T - 2L
10	18	0	-8	2T - 14L	2T - 17L	8T - 8L	8T - 11L	13T - 3L	12T - 4L	16T - 3L
18	30	0	-10	3T - 16L	3T - 20L	10T - 9L	10T - 13L	15T - 4L	14.5T - 4.5L	19T - 4L
30	50	0	-12	3T - 20L	3T - 25L	12T - 11L	12T - 16L	18T - 5L	17.5T - 5.5L	23T - 5L
50	80	0	-15	5T - 23L	5T - 29L	15T - 13L	15T - 19L	21 - 7L	21.5T - 6.5L	27T - 7L
80	120	0	-20	8T - 27L	8T - 34L	20T - 15L	20T - 22L	26T - 9L	27.5T - 7.5L	33T - 9L
120	140									
140	160	0	-25	11T - 32L	11T - 39L	25T - 18L	25T - 25L	32T - 11L	34T - 9L	39T - 11L
160	180									
180	200									
200	225	0	-30	15T - 35L	15T - 44L	30T - 20L	30T - 29L	37T - 13L	40T - 10L	46T - 13L
225	250									
250	280									
280	315	0	-35	18T - 40L	18T - 49L	35T - 23L	35T - 32L	42T - 16L	46.5T-11.5L	51T - 16L
315	355									
355	400	0	-40	22T - 43L	22T - 54L	40T - 25L	40T - 36L	47T - 18L	52.5T - 12.5L	58T - 18L
400	450									
450	500	0	-45	25T - 47L	25T - 60L	45T - 27L	45T - 40L	52T - 20L	58.5T-13.5L	65T - 20L

TABLE 8.2 FITTING AGAINST HOUSING

Unit μm

Nominal bore diameter of bearing d (mm) Over	Incl.	ΔDmp high	low	G_7	G_6	H_7	J_6	J_7	Js_7	K_6
6	10	0	- 8	5L - 28L	0 - 17L	0 - 23L	4T - 13L	7T - 16L	7.5 - 15.5L	7T - 10L
10	18	0	- 8	6L - 32L	0 - 19L	0 - 26L	5T - 14L	8T - 18L	9T - 17L	9T - 10L
18	30	0	- 9	7L - 37L	0 - 22L	0 - 30L	5T - 17L	9T - 21L	10.5T - 19.5L	11T - 11L
30	50	0	- 11	9L - 45L	0 - 27L	0 - 36L	6T - 21L	11T - 25L	12.5T - 23.5L	13T - 14L
50	80	0	- 13	10L - 53L	0 - 32L	0 - 47L	6T - 26L	12T - 31L	15T - 28L	15T - 17L
80	120	0	- 15	12L - 62L	0 - 37L	0 - 50L	6T - 31L	13T - 37L	17.5T - 32.5L	18T - 19L
120	150	0	- 18	14L - 72L	0 - 43L	0 - 58L	7T - 36L	14T - 44L	20T - 38L	21T - 22L
150	180	0	- 25	14L - 79L	0 - 50L	0 - 65L	7T - 43L	14T - 51L	20T - 45L	21T - 29L
180	250	0	- 30	15L - 91L	0 - 59L	0 - 76L	7T - 52L	16T - 60L	23T - 53L	24T - 35L
250	315	0	- 35	17L - 104	0 - 67L	0 - 87L	7T - 60L	16T - 71L	26T - 61L	27T - 40L
315	400	0	- 40	18L -115L	0 - 76L	0 - 97L	7T - 69L	18T - 79L	28.5T -68.5L	29T - 47L
400	500	0	- 45	20L -128L	0 - 85L	0 -108L	7T - 78L	20T - 88L	31.5T -76.5L	32T - 53L

Numeric value table of fitting for radial bearing of 0 class (Normal class) for metric size

TABLE 8.3 FITTING AGAINST SHAFT

Unit µm

Nominal bore diameter of bearing d (mm) Over	Incl.	Δdmp high	low	js_6	k_5	k_6	m_5	m_6	n_6	p_6	r_6
3	6	0	-8	12T - 4L	14T - 1T	17T - 1T	17T - 4T	20T - 4T	24T - 8T	28T - 12T	-
6	10	0	-8	12.5T - 4.5L	15T - 1T	18T - 1T	20T - 6T	23T - 6T	27T - 10T	32T - 15T	-
10	18	0	-8	13.5T - 5.5L	17T - 1T	20T - 1T	23T - 7T	26T - 7T	31T - 12T	37T - 18T	-
18	30	0	-10	16.5T - 6.5L	21T - 2T	25T - 2T	27T - 8T	31T - 8T	38T - 15T	45T - 22T	-
30	50	0	-12	20T - 8L	25T - 2T	30T - 2T	32T - 9T	37T - 9T	45T - 17T	54T - 26T	-
50	80	0	-15	24.5T - 9.5L	30T - 2T	36T - 2T	39T - 11T	45T - 11T	54T - 20T	66T - 32T	-
80	120	0	-20	31T - 11L	38T - 3T	45T - 3T	48T - 13T	55T - 13T	65T - 23T	79T - 37T	-
120	140										113T - 63T
140	160	0	-25	37.5T-12.5L	46T - 3T	53T - 3T	58T - 15T	65T - 15T	77T - 27T	93T - 43T	115T - 65T
160	180										118T - 68T
180	200										136T - 77T
200	225	0	-30	44.5T-14.5L	54T - 4T	63T - 4T	67T - 17T	76T - 17T	90T - 31T	109T- 50T	139T - 80T
225	250										143T - 84T
250	280										161T - 94T
280	315	0	-35	51T - 16L	62T - 4T	71T - 4T	78T - 20T	87T - 20T	101T- 34T	123T- 56T	165T - 98T
315	355										184T -108T
355	400	0	-40	58T - 18L	69T - 4T	80T - 4T	86T - 21T	97T - 21T	113T- 37T	138T- 62T	190T -114T
400	450										211T -126T
450	500	0	-45	65T - 20T	77T - 5T	90T - 4T	95T - 23T	108T- 23T	125T- 40T	153T- 68T	217T -132T

TABLE 8.4 FITTING AGAINST HOUSING

Unit µm

Nominal bore diameter of bearing d (mm) Over	Incl.	ΔDmp high	low	K_7	M_7	N_7	P_7
6	10	0	- 8	10T - 13L	15T - 8L	19T - 4L	24T - 1L
10	18	0	- 8	12T - 14L	18T - 8L	23T - 3L	29T - 3L
18	30	0	- 9	15T - 15L	21T - 9L	28T - 2L	35T - 5L
30	50	0	- 11	18T - 18L	25T - 11L	33T - 3L	42T - 6L
50	80	0	- 13	21T - 22L	30T - 13L	39T - 4L	52T - 8L
80	150	0	- 15	25T - 25L	35T - 15L	45T - 5L	59T - 9L
120	180	0	- 18	28T - 30L	40T - 18L	52T - 6L	68T - 10L
150	200	0	- 25	28T - 37L	40T - 25L	52T - 13L	68T - 3L
180	250	0	- 30	33T - 43L	46T - 30L	60T - 16L	79T - 3L
250	315	0	- 35	36T - 51L	52T - 35L	66T - 21L	88T - 1L
315	400	0	- 40	40T - 57L	57T - 40L	73T - 24L	98T - 1L
400	500	0	- 45	45T - 63L	63T - 45L	80T - 28L	108T - 0

8.3 Limits and Fits Guideline
TAPERED ROLLER BEARINGS
AFBMA RECOMMENDED FITTING PRACTICE

Shaft and housing material, geometry, hardness and surface finish must be carefully controlled. Ground shafts should be finished to 1.3 micron A.A. or better ; for turned shafts a finish of 2.5 μm A.A. or better ; and housing bores should be finished to 4 micron A.A. or better.

To avoid shearing aluminium and magnesium housing during bearing installation, steel inserts should be used ; alternatively special lubricants may be used for freezing and heating to facilitate assembly. A minimum interference fit is required for aluminium of 0.0010* per inch of diameter, for magnesium of 0.0015" per in of diameter.

Where bearings are to be pressed onto a hollow shaft, allowance must be made for contraction of the hollow shaft in order to maintain the desired radial pressure.

THE NEI PRODUCT ENGINEERING DEPARTMENT SHOULD BE CONSULTED FOR PROPER FITTING PRACTICE ON ALL SPECIAL APPLICATIONS.

AFBMA AUTOMOTIVE TAPERED CONE FITTING PRACTICE.

Use	Application	Fit Type	Cone Bore B*	Shaft Diameter B*	Fit	Cone Bore B*	Shaft Diameter B*	Fit
			Upto 3" bore			Above 3" bore		
Automotive Rotating Shafts	Pinion, transmission rear wheels, crossshaft, transfer case	Adjustable cones	+0.0005 -0.0000	+0.0005 +0.0000	0.0005T 0.0005L	+0.0010 -0.0000	+0.0015 +0.0005	0.0015T 0.0005L
		Non-Adjustable cones	+0.0005 -0.0000	+0.0015 +0.0010	0.0015T 0.0005T	+0.0010 -0.0000	+0.0025 +0.0015	0.0025T 0.0005T
	Differential	Non-Adjustable cones	+0.0005 -0.0000	+0.0025 +0.0015	0.0025T 0.0010T	+0.0010 -0.0000	+0.0035 +0.0025	0.0035T 0.0015T
Automotive Stationary Shafts	Front wheels, full floating rear wheels trailer wheels	Adjustable cones	+0.0005 -0.0000	-0.0002 -0.0007	0.0002L 0.0012L	+0.0010 -0.0000	-0.0002 -0.0012	0.0002L 0.0022L

AFBMA AUTOMOTIVE TAPERED CUP FITTING PRACTICE.

Use	Application	Fit Type	Cup O.D. D*	Housing Bore D*	Fit	Cup O.D. D*	Housing Bore D*	Fit	Cup O.D. D*	Housing Bore D*	Fit
			Less 3" O.D.			3" to 5"O.D.			Above 5" O.D.		
Auto-motive	Front wheels, full floating rear wheels pinion, differntial	Non-Adjustable cups	+0.0010 -0.0000	-0.0015 -0.0005	0.0025T 0.0005T	+0.0010 -0.0000	-0.0020 -0.0010	0.0030T 0.0010T	+0.0010 -0.0000	-0.0030 -0.0010	0.0040T 0.0010T
	Differential	Non-Adjustable cups	+0.0010 -0.0000	+0.0010 +0.0020	0.0000L 0.0020L	+0.0010 -0.0000	+0.0010 +0.0020	0.0000L 0.0020L	+0.0010 -0.0000	-0.0000 +0.0020	0.0010T 0.0020L
	Rear wheels, trans-mission, cross shaft & other application	Adjustable cups	+0.0010 -0.0000	-0.0000 +0.0010	0.0010T 0.0010L	-0.0010 -0.0000	+0.0000 +0.0010	0.0010T 0.0010L	-0.0010 -0.0000	-0.0000 +0.0020	0.0010T -0.0020L

*D - Normal cup O.D., L - Loose, T - Tight

9. BEARING HANDLING

9.1 Mounting

Rolling bearing is a very precise product and its mounting deserves careful attention. The characteristics of this bearing should be thoroughly studied, and it should be mounted in the most appropriate manner. It is desired that the assembly of the bearing be fully studied in the design and assembly departments; and standards be established with regard to following items :

1. Cleaning the bearing and related parts.
2. Checking the dimensions and finishing the related parts
3. Mounting tools.
4. Mounting methods.
5. Checking after mounting.
6. Amount of lubricant.

Mounting should be conducted carefully in accordance with the specified standards. The rotating race (usually the inner) must be made of an interference fit on its seat to prevent "creep" or slow rotation of the race relative to the shaft or housing on or in which it is mounted. It is also advisable to clamp it firmly endways. The shoulders provided should be of ample proportions to ensure a true abutment for the race, but for standard roller bearings it should be relieved at about the diameter of the roller track. In case of bearings fitted with clamping sleeves and nuts it is necessary to see that these nuts are tightened to the fullest extent, and it is an advantage if the bearings are so fitted that the rotation of the shaft has a tendency to tighten the nut on the sleeve. The importance of rigidly fixing the race upon or in the revolving part cannot be too strongly emphasised.

The stationary race (usually the outer) should be a good fit in its housing perfectly free from shake. A standard roller bearing should be clamped endways to ensure that the roller's track is in centre of the race. Deep groove ball bearing if not locating the shaft, must be left free endways, having a clearance of approximately one-third the total width of the bearings. Angular contact bearings carry radial load and thrust load in one direction but to maintain the balls in correct contact with the tracks it is necessary for the thrust to be at least equal to the radial load. Where this is not inherent in the loading conditions another ball bearing must be fitted to provide the balance of the required thrust. This is automatically applied if the opposing bearing is adjusted to take up the end play. Care is necessary to ensure that over adjustment does not too heavily preload the bearings and in this connection allowance should be made for any difference in thermal expansion of shaft and housing.

Where there is no definite end thrust the shaft mounted on deep groove ball bearings may be located by clamping endways the most lightly loaded bearings. With roller bearings, location may be effected by a bearing having lips in both races by plain faces, or by a ball locating bearing.

Set screws, keys or similar devices for fixing the races should be carefully avoided as they readily distort the rings and cause over loading of the balls or rollers.

Care should be taken to see that the shoulders between which the races are clamped are square with shaft.

Protection from dirt and moisture is most important.

PRACTICAL ADVICE

I. Storage

1. Store the bearings in a clean. dry place in their original wrappings. This will preserve them from deterioration.
2. Use older stock first.
3. Do not stack too many bearings on top of each otherwise the protective oil could be squeezed out from between the bearing and its wrapping, thus leading to corrosion problem.
4. Also, never store large bearings upright but lay them flat.

II. Fitting

1 . Absolute cleanliness is essential when handling bearings. They should not be removed from their wrappings until required for fitting. A smooth metal-topped bench that can be wiped clean is a great advantage. All tools, shaft, housings and other components must be perfectly clean. If fitting operations are delayed or interrupted, the assembly should be wrapped with grease proof paper to exclude dirt and dust.

2. Bearing of about 11 inch outside diameter and large dia are protected by heavy mineral jelly. Thus must be removed before the bearings are used, and one method is to soak the bearing in clean, hot mineral oil at a temperature not exceeding 100°C.

3. All other bearing are usually coated with a rust preventative oil, unless prelubricated and/or packed to suit individual customer requirements. There is no need to remove this oil unless :

i) It is sufficient to cause serious dilution of the oil or grease used in the bearing. This normally applies to smaller bearings where the rust preventive oil represents a lagre proportion of the required amount of lubricant.

ii) Low torque is required.

iii) A synthetic lubricant used that may not be compatible with the protecting oil.

To remove the rust preventive oil, wash the bearings in a good quality washing fluid ; white spirit or good quality paraffin is suitable.

Allow the bearings to drain thoroughly. Finally dry them, the following being satisfactory methods :

i) Place the bearings in an oven or on a hot plate, a temperature of 65-80°C should be adequate.

ii) Direct dry, clean, compressed air on the bearings. The cage and rings of smaller bearings must be held firmly otherwise a sudden blast of air would rapidly accelerate the free bearing parts, this could cause the balls to skid, thus damaging the highly finished internal surfaces of the bearing.

4. The fits of the rings on their seatings are very important Therefore ensure that the shaft and housing seatings are of correct size and of good shape.

5. All shoulders must be smooth and square with the axis of rotation.

6. Never drive one ring on its seating by blows on the other. Such blows would irretrievably damage the balls or rollers and raceways.

7. Apply pressure evenly around the rings. **"A press is better than a hammer."**

8. Should a hammer be used, mild steel or brass tube of suitable size, faced up square, should be interposed between it and the bearing. This will distribute the force of the blows (or rather taps), which should be given progressively around the ring.

9. When the parts or a separable roller bearings are brought together, the inner ring, the outer ring and the rollers must all be square one with the other. If not square, then the rollers would not slide freely, and force would have to be used to bring the parts together. Such force would result in the rollers and raceways becoming scored and this, in addition to causing noisy running could cause early failure of the bearing.

10.Where the ring of a bearing is against an abutment, make sure it is tight home.

11. For heavy interference fits, inner rings may be shrunk on to the seatings after heating in clean mineral oil at a temperature of approximately 100°C: Be sure that the bearing is in contact with the abutment shoulder after it has cooled.

12. In this case of taper clamping sleeve and nut bearings, the clamping nut must not be overtightened, for this could expand the inner ring and eliminate all clearance within the bearing, or even fracture the inner ring. We recommend that when using pin spanners, having a length of approximately five times the shaft diameter, one or two light hammer blows should be given to the handle of the spanner after the nut has been tightened as far as possible by hand pressure. This should tighten the nut just sufficiently. It is a good practice.

If possible, to check that the sleeve is still clamped firmly to the shaft after a few days running. As an additional precaution we recommend that whenever possible, the bearings are fitted so that the rotation of the shaft tends to tighten the nut on the sleeve. To assist customers who use torque spanners we recommend that the following torque be applied to the clamping nut for light series bearings.

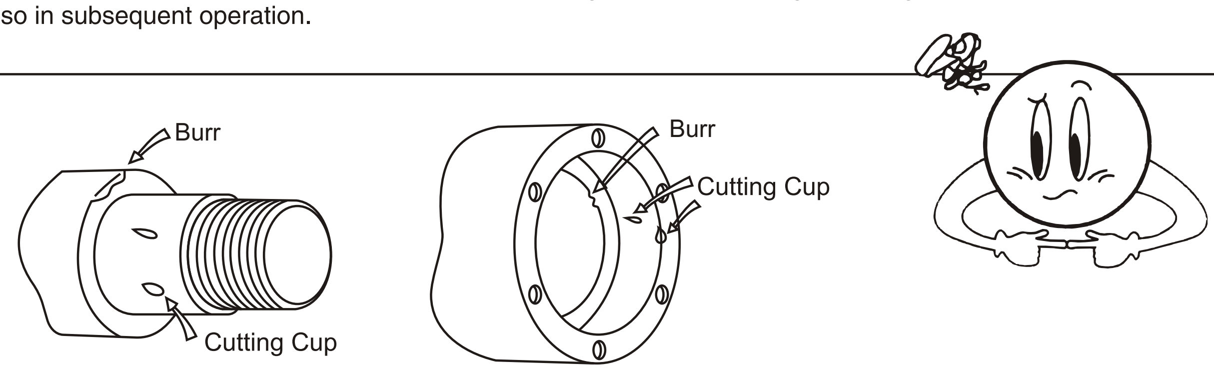
Shaft Diameter	Torque on Nut
1"(25mm)	7.6 Kg.m
1 .5" (38 mm)	12.4 Kg.m
2" (50 mm)	17.25 Kg.m
3" (75 mm)	30.3 Kg.m

For medium series bearing we recommend that the above figures be increased by approximately 50 percent.

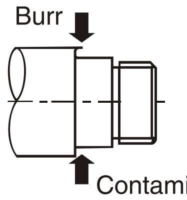
9.1.1 Bearing Mounting Procedure

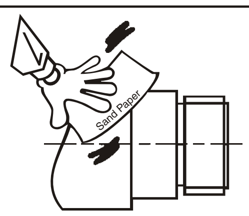
Any burrs, cutting chips, rust or dirt should first be removed from the bearing mounting surfaces. Installation then be simplified if the clean surfaces are lubricated with spindle oil.

Burrs, dirt, and other contaminants that infiltrate the bearing before and during mounting will cause noise and vibration and also in subsequent operation.

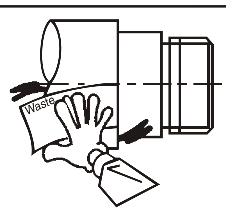


9.1.2 Preparation Procedure



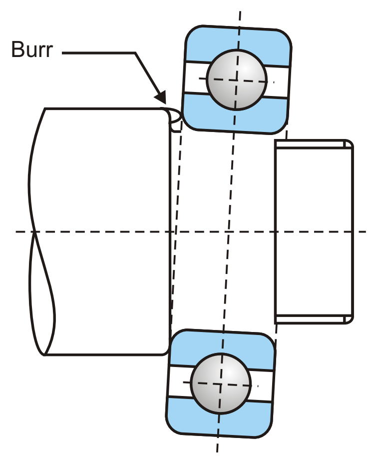


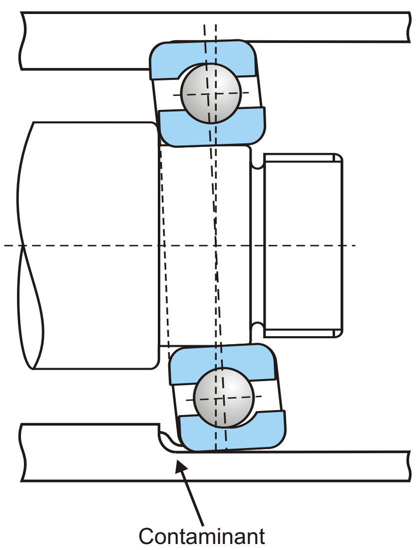
Remove any burr with fine grade sand paper



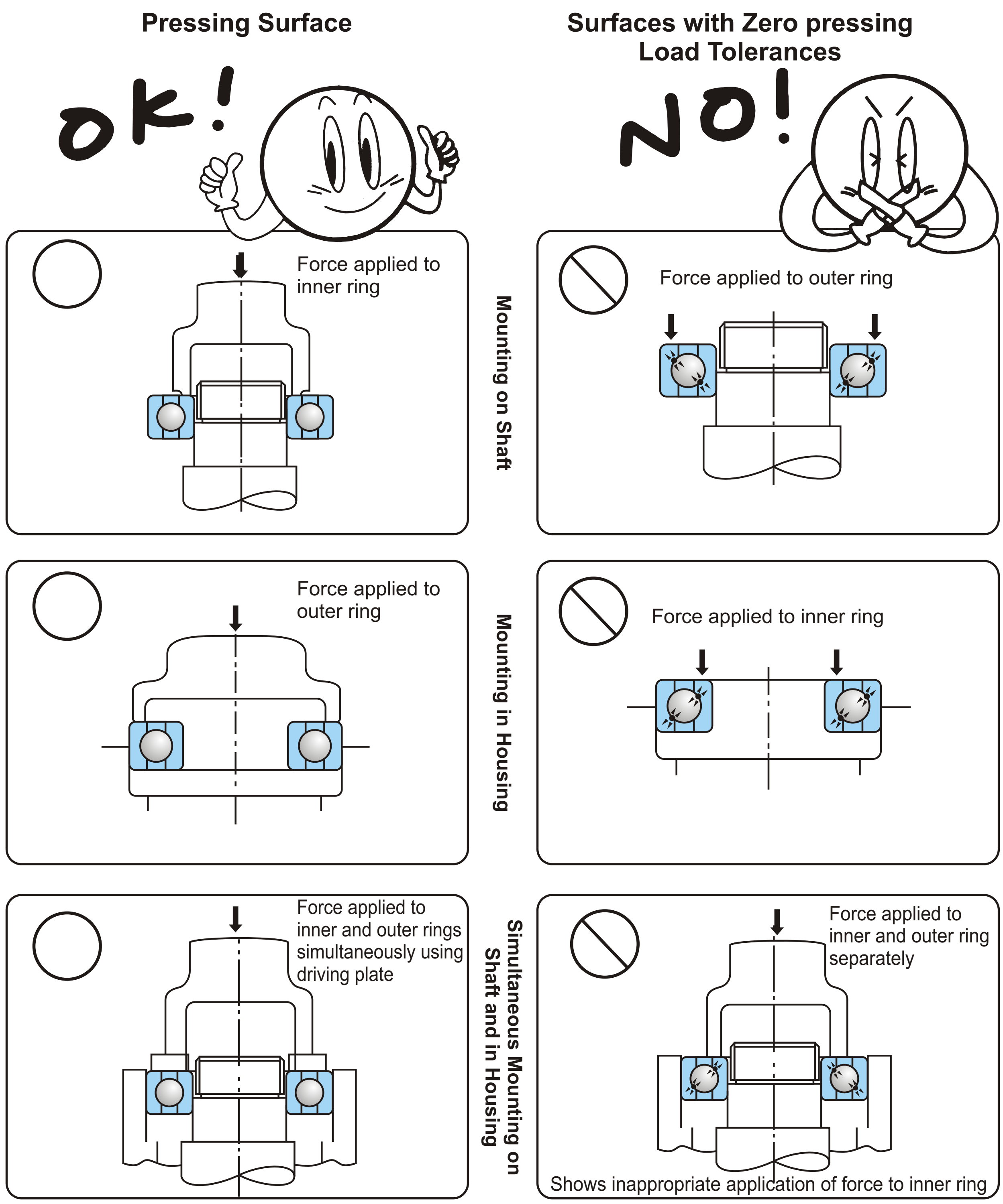
Remove any dirt and contaminants with a clean paper.

Apply light coating oil.





Mounting Procedure

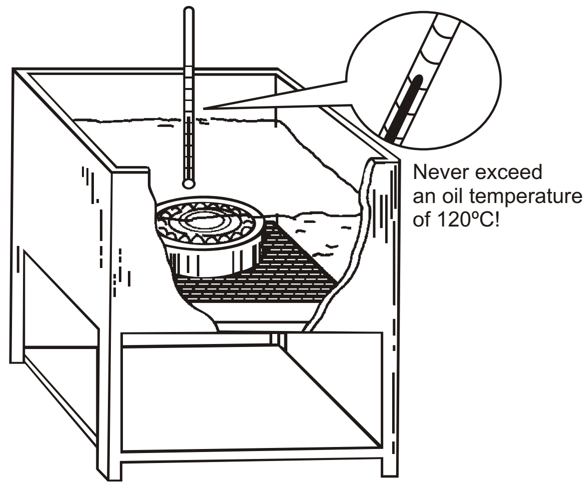


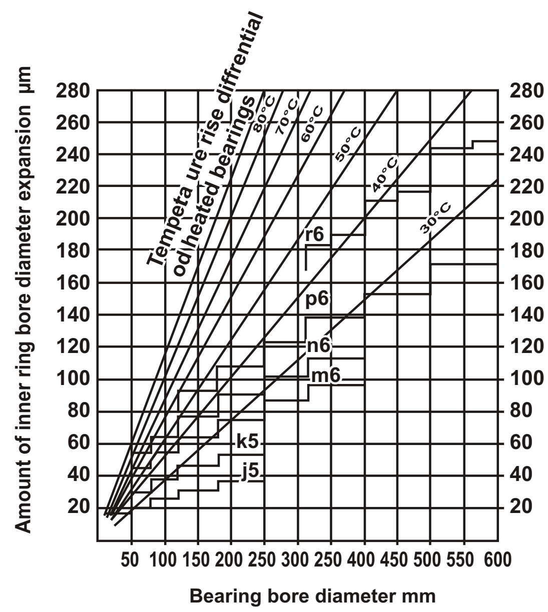
9.1.3 Temperature Mounting

(Heat expansion of inner ring to ease installation)

Commonly used for large bearings and bearings with a heavy interference fit.

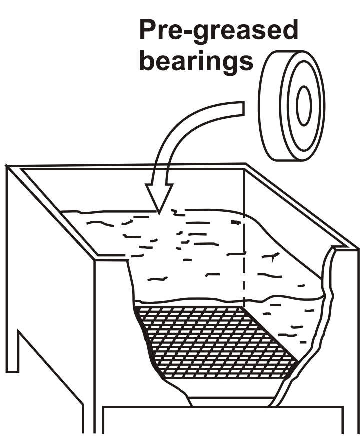
1. Immersion of the bearing in heated oil is the most common method.
   Use clean oil and suspend the bearing in the oil with a wire or support it underneath using a metal screen in order to avoid uneven heating of bearing elements.
2. The temperature to which the inner ring should be heated depends upon the amount of interference fit i.e. the diameter of the interference fit surfaces. Refer to the following graph to determine the proper temperature.
3. To prevent gaps from occurring between the inner ring and shaft shoulder, bearings which have been heated and mounted on the shaft should be held in place until they have cooled completely.

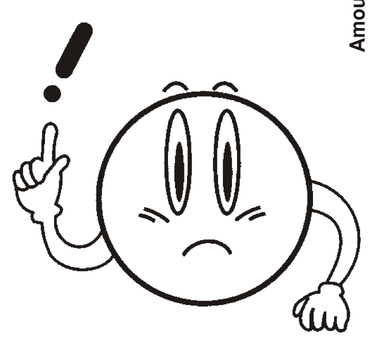




Observe these precautions when heating bearings

1. bearings should never be heated over 120°C.
2. This temperature mounting method cannot be used for pre-greased and sealed bearings or shielded bearings.

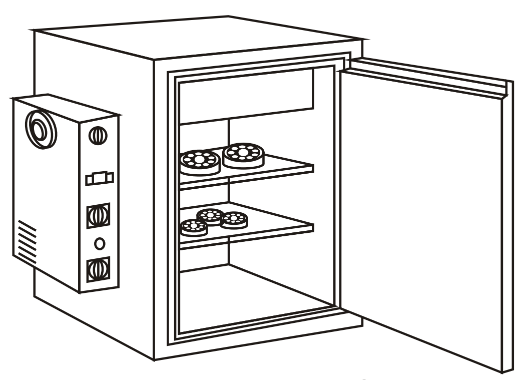




Other heating methods

1. **Bearing Oven**
   Bearings are dry. This method can also be used for pre-greased bearings.
   Do not heat the bearings above 120°C.

2. **Induction Heating**
   This method can also be used for the inner rings of cylindrical roller bearings. Bearings are dry and can be heated up in a short period of time. After using this method, administer a demagnetizing treatment to the bearing.



Bearing Oven

9.2 Dismounting & Replacement

1. Unnecessary removal of a bearing should be avoided, particularly where interference fits have been used. Removal can damage the bearing and in some instances, cause deterioration of the interference fit. Very often it is sufficient to clean and relubricate the bearing in its fitted position. Remove a bearing if you need to inspect it closely. Symptoms that guide are the condition of the lubricant, the bearing temperature and the noise level.

2. With Roller bearings there is sometimes a Ball location bearing. This may be only a push fit on the shaft, and therefore, facilitates easy dismantling.

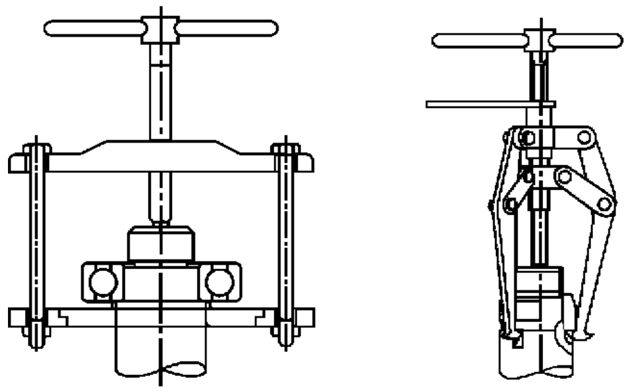
3. In certain applications some form of extractor may be necessary. This may act directly on the ring to be removed. Never try to remove the inner ring by applying force on the outer ring or vice versa.

4. Thrust bearings need offer no difficulty as push fits should have been used, but take care to keep the rings square or they will bend.

5. Worn shafts, housings and abutments must have attention if creep has occurred. Knurling, scoring or distortion of the seating on which creep has occurred must not be resorted to simulate an interference fit. Such deceptive practices are ineffective, for creep will very often return all too quickly. Also, even if the ring is prevented from creeping it will usually be distorted by the seating, with bearing failure resulting from local overloading ofthe raceways and of the balls or rollers.

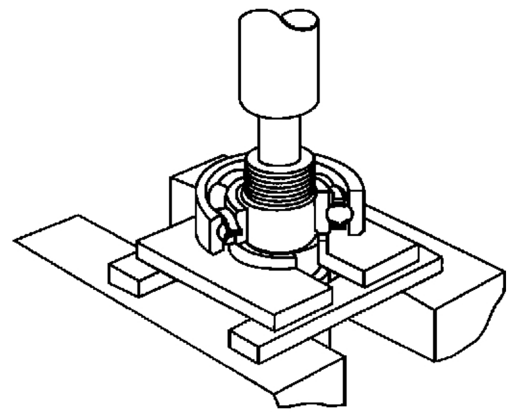
6. When ordering replacements, be sure to give the symbols marked on each of the rings of the bearing if any doubt exists as to the correct bearing number. If a housing or seating ring etc. is supplied with the bearing, please also quote the marking on it. This is especially important for thrust bearings with housings or seating rings, and for externally aligning bearings. It is necessary to ensure that the correct radial clearance is mentioned for ball and roller bearings being ordered.

BEARING REMOVAL TOOLS & PROCEDURE

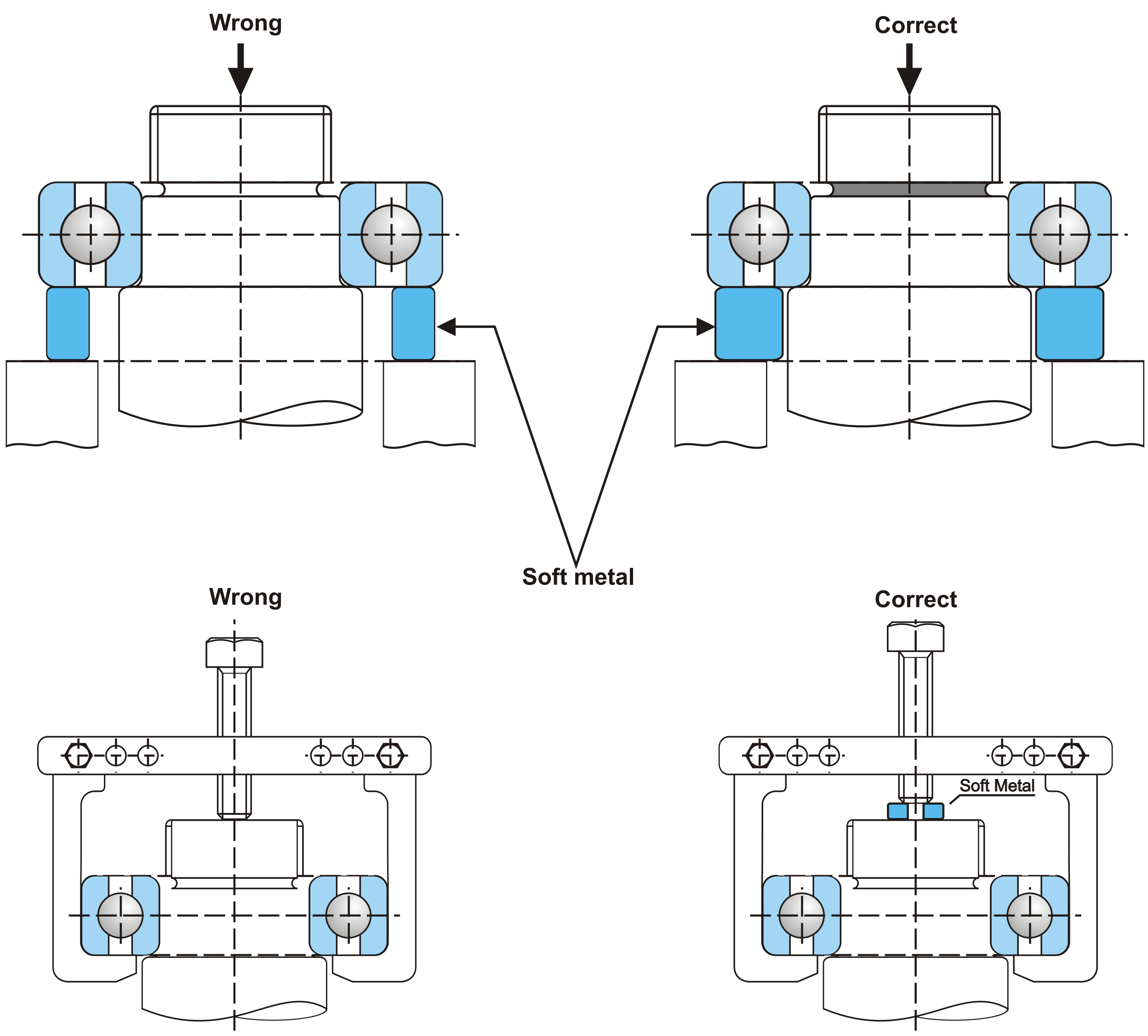


(a) (b)

Removal Using a Bearing puller



Removal Using a spacer



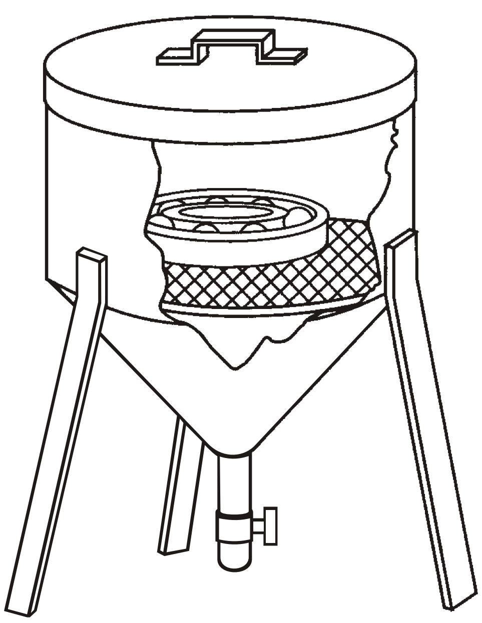
9.3 Bearing Cleaning

It is seldom necessary to clean bearings with the sole object of removing the rust preventive oil, which they are coated before being packed. Rust preventives with a petroleum jelly base have certain lubrication qualities and in any case since the amount used for the protection of bearings is small, no harm is done with the grease or oil used for lubrication.
As a rule washing shall only be resorted to when bearings have become dirty or when the mechanism in which they are used is so sensitive that even slight irregular resistance to rotation is not permissible. Cleaning media most commonly employed for used bearing are :
(a) Benzene, (b) White Spirit (Low flash point), (c) Turpentine, (d) Paraffin Oil, (e) Light Spindle Oil, (f) Trichloro Ethylene, (g) Carbon Tetra Chloride; (h) Petroleum Ether

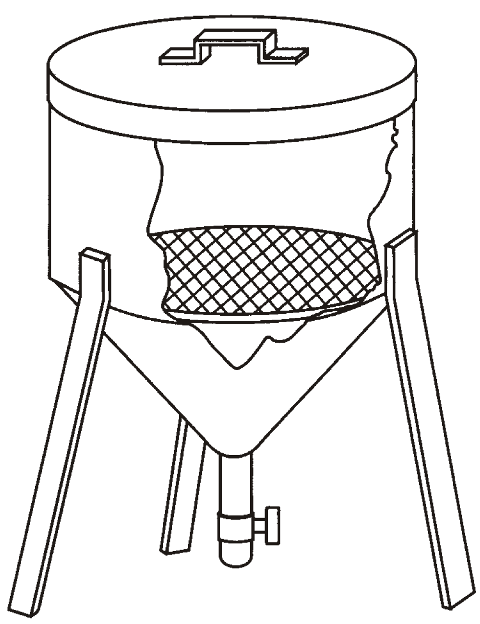
- **METHOD OF CLEANING**

Rough cleaning
In Rough Cleaning a separate container should be used and to support the bearing a screen should be provided. All the cleaning media as mentioned above can be used for cleaning bearing, if bearing is very dirty, Gasoline should be used. Care should be taken to prevent igniting and to prevent rusting after cleaning.
In rough cleaning, each bearing is moved about vigorously without rotating it, since any trapped foreign matter can scratch the rolling elements & tracks. If the oil is heated it cleans the bearing effectively. However, never heat the oil above 100°C. After as much as possible of the dirt has been removed this way, the bearing is transferred to the final cleaning.

Final cleaning
Now bearing is submerged in clean oil & rotated gently the inner ring or outer ring so that inside of the bearing will also be cleaned. After that, rotate the bearing faster until all trace of dirt has been removed. Now remove the bearing from bath and wipe it with a clean cloth, apply a coat of rust preventive oil to the bearing and wrap it is not going to be used immediately. It is necessary to always keep rinsing oil clean.
After any cleaning process it is necessary to protect the bearing by dipping it in hot petroleum jelly or oil, or by applying the grease to be used that it reaches every part of the surface. In the latter case rotation of bearings is necessary while grease is being applied.



Rough cleaning



Final cleaning

9.4 Abutments for Bearings

1. Shaft and housing abutments for a ball or roller bearing must be flat and square with the axis of rotation.
2. An abutment must be deep enough to clear the unground corner radius of a bearing ring and contact its ground face.
3. The radius at the root of an abutment must be smaller than the corner radius of the ring located against that abutment, alternatively the root may be undercut.
4. The edge of an abutment must be reduced or chamfered, as a burred edge can so easily dent or distort a bearing ring.

Ball Journal, Angular Contact and Duplex Bearings

When a bearing carries heavy axial load, abutments must be deeper i.e. they should not extend beyond the inner ring outside diameter or below the outer ring bore. A deep abutment can cause difficulties when a bearing is removed from its seating and, therefore, it is advantageous to provide grooves or holes on such an abutment so that a suitable extraction tool can be used.

Roller Journal Bearings

Bearings not carrying axial loads or taking location duty

The maximum abutment depth is more important ring for these bearings than for ball bearings, and maximum inner abutment diameter and minimum outer ring abutment diameter are recommended accordingly. Broadly these coincide with the diameter of the inner and outer ring raceways respectively.

Bearings carrying axial laods and taking location duty

Abutments for these bearings should extend beyond the raceways to avoid shear stresses in the lips. Every possible care is necessary to ensure that the abutments are flat and square with the axis of rotation.

Thrust Bearings

Abutments for Thrust bearings should extend beyond the pitch circle diameter of the balls to prevent the washers dishing under load.

For standard Thrust bearings with one small bore washer and one large bore washer, the approximate pitch circle diameter

$$= \frac{\text{Small bore diameter} + \text{Large outside diameter}}{2}$$

In case of bearings with two bore washers, use the pitch circle diameter for the same basic bearing size with one large bore washer and one small bore washer as above

10. BEARING FAILURE

10.1 Why Bearings Fail

In general, if rolling bearings are used correctly they will survive to their predicted fatigue life. However, they often fail prematurely due to avoidable mistakes. Failure of the rolling bearing can occur for a variety of reasons. Accurate determination of the cause of a bearing failure is must to make suitable recommendations for eliminating the cause.

The major factors that singly or in combination may lead to premature failure during service include incorrect mounting, excessive loading, excessive preloading, inadequate & insufficient lubrication, impact loading, vibrations, contamination, entry of harmful liquids.

It is difficult to determine the root cause of some of the premature failures. If all the conditions at the time of failure, and prior to the time of failure are known, including the application, operating conditions and environment, then by studying the nature of failure and its probable causes, the possibility of similar future failures can be reduced.

Two or more failure pattern can occur simultaneously and can thus be in competition with one another to reduce the bearing life. Also a pattern of failure that is active for one period in the life of a bearing can lead to or can even be followed by another failure mechanism, which then cause premature failure. Thus in some instances, a single failure pattern will be visible and in other indications of several failure pattern will be evident, making exact determination of root cause difficult. So when more than one bearing failure pattern has been occurred, proper analysis depends on careful examination of failed components. In contrast to fatigue life, this premature failure could be caused by :

(1) IMPROPER MOUNTING
(2) IMPROPER HANDLING
(3) POOR LUBRICATION ,
(4) CONTAMINATION
(5) EXCESSIVE HEATING
(6) EXCESSIVE LOAD

CAUSES OF OPERATING IRREGULARITIES IN A BEARING :

When certain irregularities are observed in a bearing, causes mentioned below should be checked and suitable corrective measures should be taken.

(A) Noise :

Possible causes are :

(1) Contact of rotating parts
(2) Faulty mounting
(3) Insufficient / inadequate lubricant
(4) Abnormal load
(5) Improper internal clearance
(6) Sliding of rolling element
(7) Presence of contamination
(8) Corrosion
(9) Occurrence of flaking on raceways / rolling elements.
(10) Brinelling due to careless handling.

(B) Abnormal Temperature :

Possible causes are :

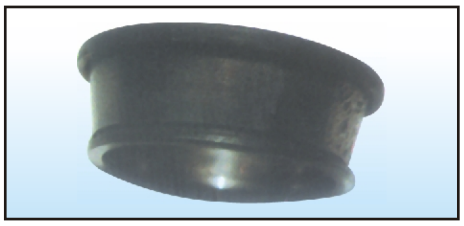
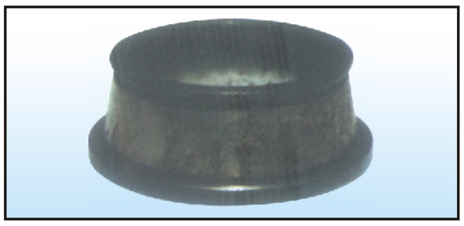
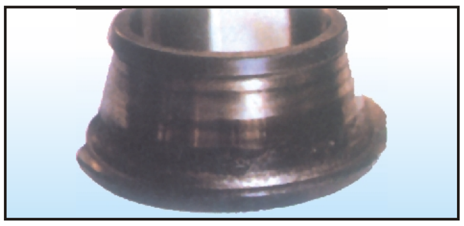
1. Friction in bearing due to contact of rolling parts & seals.
2. Excessive amount of lubricant
3. Insufficient lubricant
4. Improper lubricant
5. Incorrect mounting
6. Excessive load on bearing

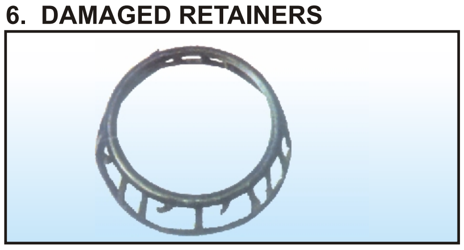
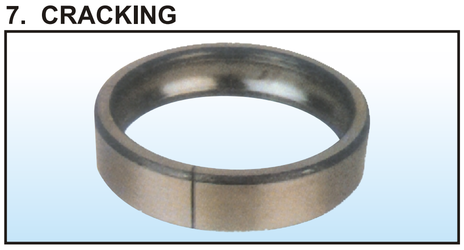
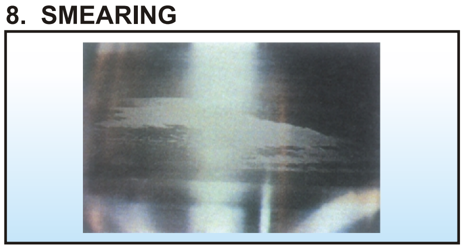
(C) VIBRATION :

Possible causes are :

1. Occurrence of brinelling, flaking
2. Incorrect mounting
3. Existence of foreign objects

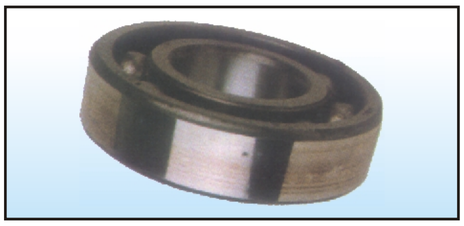
10.2 Bearing Damage and Corrective Measures

DESCRIPTION	CAUSES	COUNTER MEASURES
1. FLAKING 	* Abnormal excessive load * Deflection of misalignment of shaft * Poor Lubrication * Ingress of foreign objects	* Correct accuracy of shaft & housing * Improve mounting & alignment * Review quantity & type of lubricant * Carefully clean & handle shaft and housing
	* Non uniform dustribution of lubricant * Etching	* Uniform distribution of grease * Review the mounting procedure * Improve operating conditions
	* Excessive preload	* Correct the amount of preload * Use torque wrench to achieve correct preload
	* Excessive Axial load * Inadequate lubrication * Contamination	* Review application conditions. * Review quantity & type of lubricant * Carefully clean & handle shaft and housing
2. PEELING 	* Foreign Matter * Improper lubrication	* Review type of lubricant & lubrication method * Improve sealing efficiency
3. SEIZURE 	* Loss of clearance * Insufficient lubrication * Excessive load * Roller Skew	* Review fitting & bearing clearance * Select a proper lubricant & feed it in proper quantity * Prevent misalignment * Improve method of mounting

DESCRIPTION	CAUSES	COUNTER MEASURES
4. DISCOLOURATION 	* Ingress of foreign objects * Poor lubrication * Temper colour by overheating * Deposition of Deteriorated oil on surface	* Oil deposition should be removed by wiping with suitable solvent * Select a proper lubricant & feed it in proper quantity
5. FRETTING CORROSION 	* Minute clearance on fit surface * Slight sliding during operation as a result reduced interference under a load * Swing with smaller amplitude * Vibration during transportation	* Fix shaft & housing * Increase interference * Apply oil * Change lubricant * Use oil or high consistency grease when used for oscillation motion
6. DAMAGED RETAINERS 	* Excessive load * Impact load * Improper lubrication * Excessive vibration * Ingress of foreign objects	* Select a proper lubricant & feed it in proper quantity * Review of application conditions * Investigate shaft and housing rigidity * Correct the method of mounting & handling
7. CRACKING 	* Excessive impact load * Excessive load * Excessive interference fit * Bearing seat has larger corner radius than bearing * Slipping of balls due to poor lubrication * Excessive clearance during operation	* Re-evaluate load conditions * Check fits & bearing clearance * Improve the rigidity of shaft & housing * Correct the method of mounting & handling
8. SMEARING 	* Insufficient lubrication * Ingress of foreign objects * Jamming of rolling elements in cage pockets * Improper mounting * Angular movement of shaft while bearings are stationary under load * Excessive slippage of the rolling elements * Excess axial load	* Select a proper lubricant, quantity & method * Review the load conditions * Improve the sealing * Correct mounting faults * Clean the shaft & housing * Setting of a suitable preload
9. EXCESSIVE WEAR 	* Coarse/Fine matter in the bearing & acts as lapping agents * Insufficient lubrication * Rotational creep due to loose fit * Skewing of Rollers * Inner or outer ring out of square	* Improve sealing * Check lubricant type & amount * Check shaft & housing * Correct mounting faults

DESCRIPTION | **CAUSES** | **COUNTER MEASURES**

10. CREEPING



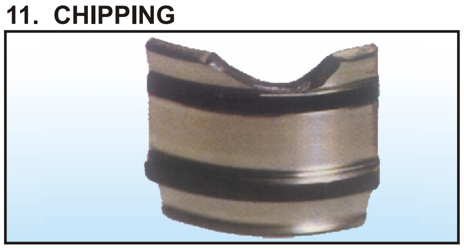
Causes

* Insufficient interference in the mating parts
* Insufficient sleeve tightening
* Insufficient surface pressure

Counter Measures

* Review the fits
* Review the usage conditions
* Redesign for greater rigidity

11. CHIPPING



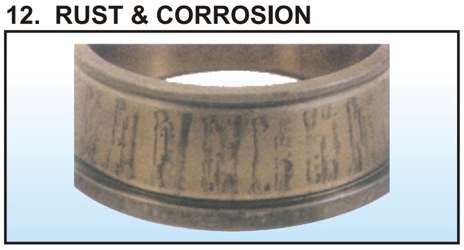
Causes

* Impact of excessive load
* Poor handling
* Ingress of solid objects

Counter Measures

* Improve handling
* Improve sealing
* Review application conditions

12. RUST & CORROSION



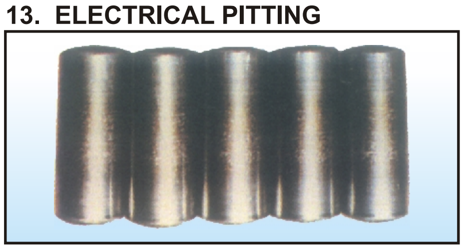
Causes

* Improper storage, cleaning
* Poor packaging
* Insufficient rust inhibitor
* Poor rust prevention
* Chemical action of lubricant
* Penetration by water, acid etc.

Counter Measures

* Improve storage & handling
* Improve sealing
* Periodically inspect the lubricating oil
* Take care when handling the bearing

13. ELECTRICAL PITTING



Causes

* Continuous passage of electric current
* Intermittent passage of electric current

Counter Measures

* Create a bypass circuit for the current
* Insulate the bearing so that current does not pass through it.

14. ROLLERS SKEWING

Causes

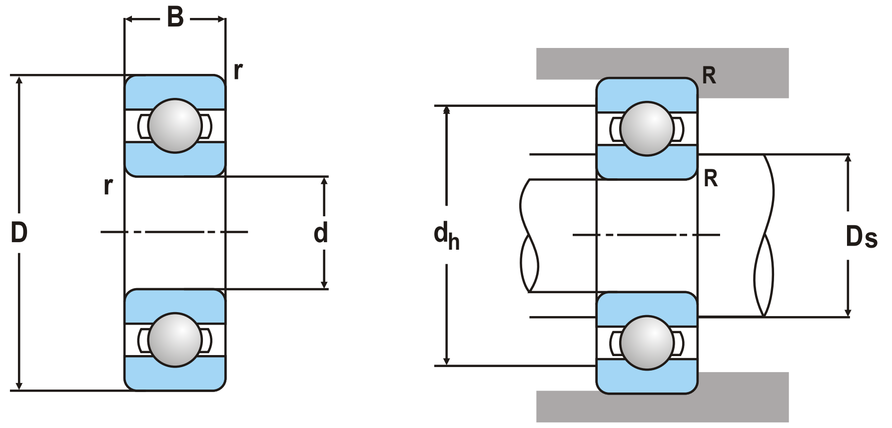
* Deformation or tilt of bearing ring due to poor accuracy of shaft or housing
* Poor rigidity of shaft or housing
* Deflection of shaft due to excessive clearance

Counter Measures

* Improvement in machining accuracy of shaft and housing
* Improvement in rigidity of shaft and housing.
* Employment of adequate clearance

11. BEARING TABLES

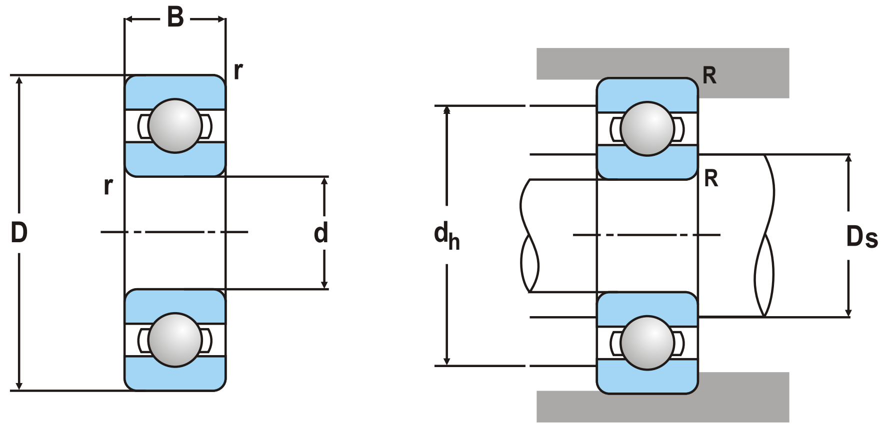
● SINGLE ROW RADIAL BALL BEARING



METRIC SERIES

Boundary Dimensions (mm) d	D	B	r min.	Basic Load Rating (N) Dynamic C	Static Co	Limiting Speed (rpm) Grease	Oil	Bearing Number	Abutment and Fillet Dimensions Ds max.	Ds min.	dh	R max.	Mass kg (Approx.)
10	26	8	0.3	4550	1960	29000	34000	6000	13.5	12	24	0.3	0.019
	30	9	0.6	5980	2640	25000	30000	6200	16	14	25	0.6	0.030
	35	11	0.6	6780	3320	23000	27000	6300	17	14	31	0.6	0.053
12	24	6	0.3	2890	1460	27000	32000	6901	15	14	22	0.3	0.011
	28	8	0.3	5100	2390	26000	30000	6001	16	14	26	0.3	0.021
	32	10	0.6	6100	2750	22000	26000	6201	17.5	16	27	0.6	0.036
	37	12	1.0	9700	4200	20000	24000	6301	18.5	17	31	1.0	0.061
	40	12	1.0	11400	5000	18000	21000	613963	17.5	16	35.5	1.0	0.072
15	28	7	0.3	4100	2060	24000	28000	6902	18	17	26	0.3	0.016
	32	9	0.3	5600	2840	22000	26000	6002	19	17	30	0.3	0.030
	32	8	0.3	5600	2840	22000	26000	16002	19	17	30	0.3	0.025
	35	11	0.6	7750	3600	19000	23000	6202	20.5	19	31	0.6	0.046
	42	13	1.0	11400	5450	17000	21000	6302	23	20	37	1.0	0.084
16	42	13	1.0	9600	4550	17000	21000	BB1002	21	19	36	1.0	0.084
17	30	7	0.3	4650	2580	20000	24000	6903	20	19	28	0.3	0.018
	35	8	0.3	6800	3350	20000	24000	16003	-	19	33	0.3	0.032
	35	10	0.3	6800	3350	20000	24000	6003	21	19	32.5	0.3	0.039
	40	12	0.6	9600	4600	18000	21000	6203	23	21	35	0.6	0.065
	42	12	0.6	11600	5700	8000	21000	6203A/42	23	21	37	0.6	0.078
	47	14	1.0	13500	6550	16000	19000	6303	25	22	41	1.0	0.116
20	42	8	0.3	7400	4000	16000	18000	16004	24	22	36	0.3	0.049
	42	9	0.6	8650	4500	15000	18000	98204	25	22	37	0.6	0.052
	42	12	0.6	9400	5050	18000	21000	6004	26	24	38	0.6	0.069
	47	14	1.0	13700	6700	16000	18000	6204	28	25	41	1.0	0.103
	47	15.88	0.6	13700	6700	16000	18000	BB1003	26	24	42	0.6	0.120
	50	14	1.0	13700	6700	16000	18000	1838002	26	24	42	1.0	0.125
	52	15	1.1	15900	7850	14000	17000	6304	28.5	26.5	45	1.1	0.147
	55	11	1.1	15900	7850	14000	17500	20X55X11	37	35	50	1.0	0.136
	62	16	1.0	23400	12200	10000	12000	BB1063	39	35	57	1.0	0.254
22	52	15	1.0	15900	7850	14000	17000	6304/22	28.5	26.5	45	1.1	0.130
25	42	9	0.3	7050	4550	16000	19000	6905	29	27	40	0.3	0.042
	47	8	0.3	8350	5100	15000	18000	16005	-	27	45	0.3	0.060
	47	12	0.6	10000	5850	15000	18000	6005	30.5	29	43	0.6	0.078
	52	9	0.6	11600	6500	14000	17000	98205	31	29.5	46	0.6	0.085
	52	15	1.0	14000	7850	13000	15000	6205	32	30	46	1.0	0.129
	62	12	0.6	19500	11300	13500	16000	1838001	32	30	55	0.6	0.176
	62	17	1.1	21200	10900	12000	14000	6305	35	31.5	55	1.1	0.225
	72	17	1.1	21200	10900	12000	14000	SP72X25X17	36	32	65.5	1.5	0.370
25.5	72	19	1.1	27100	14500	10000	12000	872489	37	35	65	1.1	0.363

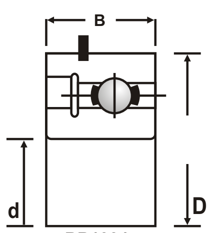
SINGLE ROW RADIAL BALL BEARING



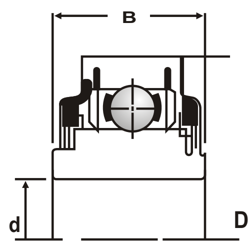
METRIC SERIES

Boundary Dimensions (mm)				Basic Load Rating (N)		Limiting Speed (rpm)		Bearing Number	Abutment and Fillet Dimensions				Mass kg (Approx.)
d	D	B	r min.	Dynamic C	Static Co	Grease	Oil		D_s max.	min.	d_h	R max.	
28	58	16	1.0	17900	9750	12000	14000	62/28	35.5	33	53	1.0	0.171
	68	18	1.1	26700	14000	11000	13000	63/28	38.5	34.5	61.5	1.1	0.284
	72	18	1.5	25700	15400	9800	11000	72X28X18	45.0	41.5	65.5	1.5	0.350
30	55	13	1.0	13200	8300	13000	15000	6006	37	35	50	1.0	0.116
	55	11	1.0	13200	8300	13000	15000	SP6006	37	35	50	1.0	0.100
	55	9	0.3	11200	7350	13000	15000	16006	-	32	53	0.3	0.091
	62	16	1.0	19500	11300	11000	13000	6206	39	35	57	1.0	0.201
	72	19	1.1	27100	14500	10000	12000	6306	43	36.5	65.5	1.1	0.334
	90	23	1.5	40600	22800	7800	9200	6406	40	38	81.5	1.5	0.698
35	62	9	0.3	11700	8200	12000	14000	16007	-	37	60	0.3	0.110
	62	14	1.0	16000	10300	12000	14000	6007	42	40	57	1.0	0.154
	72	17	1.1	25700	15300	9800	11000	6207	45	41.5	65.5	1.1	0.280
	80	21	1.5	33400	19200	8800	10000	6307	47	43	72	1.5	0.457
	100	25	1.1	48300	27800	7800	9100	6407	47	43	92	1.1	0.925
40	80	18	1.1	29100	18000	8700	10000	6208	51	46.5	73.5	1.1	0.357
	90	23	1.5	40600	22900	7800	9200	6308	54	48	82	1.5	0.599
	110	27	1.1	61900	38000	7000	8200	6408	54	49	101	1.1	1.21
45	75	16	1.0	21000	15100	9200	11000	6009	52.5	50	70	1.0	0.237
	85	19	1.1	32700	20500	7800	9200	6209	55.5	7.5	78.5	1.1	0.400
	100	25	1.5	53000	32000	7000	8200	6309	61.5	53	92	1.5	0.825
	120	29	1.1	71500	44400	6300	7400	6409	60	54	111	1.1	1.550
50	80	16	1.0	21800	16600	8400	9800	6010	57.5	55	75	1.0	0.262
	90	20	1.1	35000	23200	7100	8300	6210	60	56.5	83.5	1.1	0.457
	110	27	2.0	61900	38000	6400	7500	6310	68.5	59	101	2.0	1.065
55	100	21	1.5	43400	29300	6400	7600	6211	67	63	92	1.5	0.597
	120	29	2.0	71500	44400	5800	6800	6311	74	64	111	2.0	1.372
60	110	22	1.5	50700	33000	6000	7000	6212	75	68	102	1.5	0.783
	130	31	2.1	81800	52000	5400	6300	6312	80.5	71	119	2.1	1.689
65	120	23	1.5	57200	40100	5500	6500	6213	80.5	73	112	1.5	0.980
	140	33	2.1	92100	59800	4900	5800	6313	86	76	129	2.1	2.091
70	125	24	1.5	62200	44100	5100	6000	6214	85	78	116.5	1.5	1.056
75	130	25	1.5	62100	44900	4800	5600	6215	90.5	83	121.5	1.5	1.139

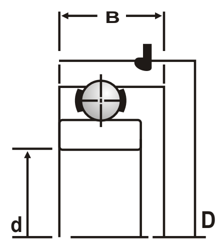
SINGLE ROW RADIAL BALL BEARING (SPECIAL BEARINGS)



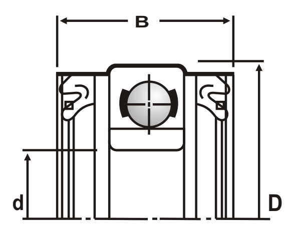
BB1004



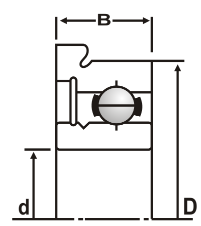
BB1005



BB1014



BB1019



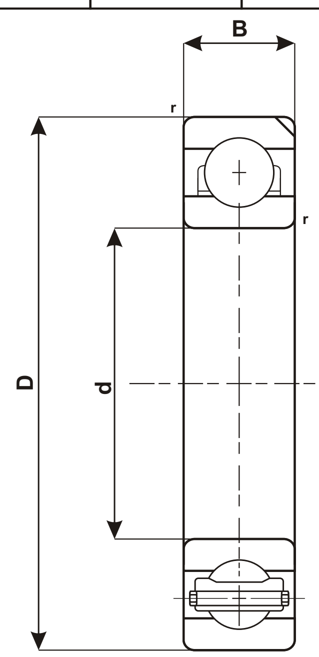
BB1016

METRIC SERIES

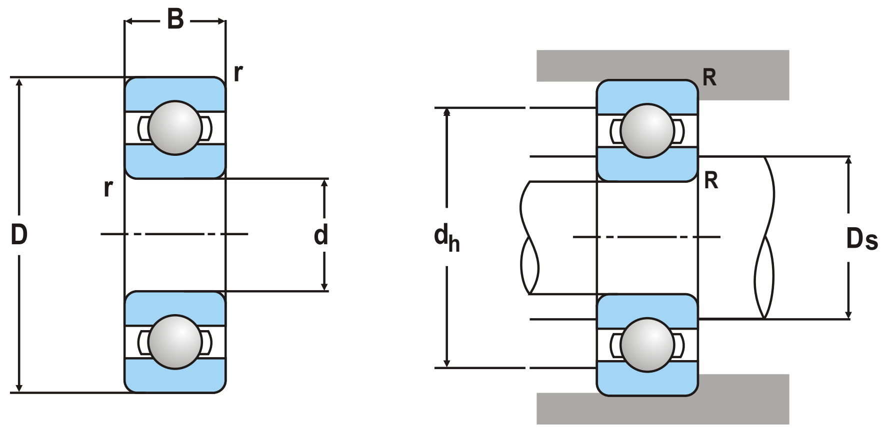
Boundary Dimensions (mm)				Basic Load Rating (N)		Limiting Speed (rpm)		Bearing Number	Abutment and Fillet Dimensions		
d	D	B	r min.	Dynamic C	Static Co	Grease	Oil		D_s max.	d_h min.	R max.
25	52	18	1.5	11500	6200	13000	15000	BB1004	30	47	1
25	52	18	1.0	11500	6200	13000	15000	BB1016	30	46	1
25	65	21.5	2.0	21300	9800	12000	14000	BB1014	32	56	1
40	82	50	-	29100	17200	8700	10000	BB1019	-	-	-
45	85	27	1.6	32500	19800	7800	9200	BB1005	51	70	1

BALL BEARING

Boundary Dimensions (mm)				Bearing	Basic Load Rating (N)		Type	Mass Kg. (approx.)
d	D	B	r		Dynamic 'C'	Static 'Co'		
630	920	128	10	60/630	816000	176000	Ball Bearing	280.00



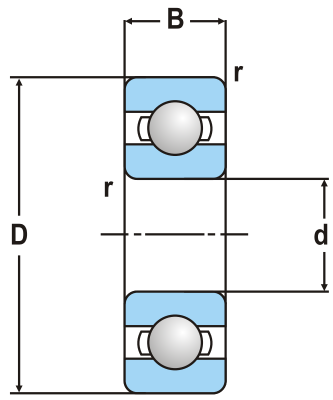
SINGLE ROW RADIAL BALL BEARING

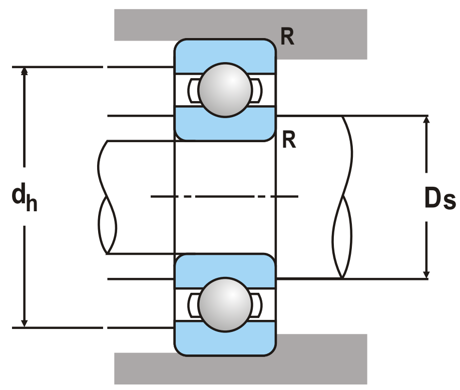


INCH SERIES

Boundary Dimensions				Basic Load Rating (N)		Limiting Speed (rpm)		Bearing Number	Abutment and Fillet Dimensions			Mass kg (Approx.)
d mm (inch)	D mm (inch)	B mm (inch)	r mm (inch)	Dynamic C	Static Co	Grease	Oil		D_s mm (inch)	d_h mm (inch)	R mm (inch)	
9.525 (0.3750)	22.225 (0.8750)	5.556 (0.2188)	0.4 (0.02)	2490	1110	32000	44000	S3	12.7 (0.5)	18.3 (0.72)	0.3 (0.01)	0.010
12.700 (0.5000)	28.575 (1.1250)	6.350 (0.2500)	0.4 (0.02)	4030	2010	23500	27000	S5	17.5 (0.69)	23.8 (0.94)	0.3 (0.01)	0.019
	33.338 (1.3125)	9.525 (0.3750)	0.8 (0.03)	6100	2750	20000	24000	LS5	17.5 (0.69)	29.5 (1.16)	0.5 (0.02)	0.037
15.875 (0.6250)	34.925 (1.3750)	7.144 (0.2813)	0.8 (0.03)	5550	2860	19000	23000	S7	20.6 (0.81)	28.6 (1.13)	0.5 (0.02)	0.033
	39.688 (1.5625)	11.113 (0.4375)	0.8 (0.03)	9600	4550	19000	23000	LS7	21.1 (0.83)	34.8 (1.37)	0.5 (0.02)	0.059
	46.038 (1.8125)	15.875 (0.6250)	1.6 (0.06)	11600	5650	16000	18000	MS7	23.1 (0.91)	39.6 (0.56)	1.1 (0.04)	0.120
19.050 (0.7500)	41.275 (1.6250)	7.938 (0.3125)	0.8 (0.03)	7380	4000	16000	18000	S8	26.2 (1.03)	35.7 (1.41)	0.5 (0.02)	0.047
	47.625 (1.875)	14.288 (0.5625)	1.6 (0.06)	13700	6650	15000	18000	LS8	25.9 (1.02)	41.1 (1.62)	1.1 (0.04)	0.110
	50.800 (2.0000)	17.463 (0.6875)	1.6 (0.06)	15900	7850	14500	17000	MS8	26.9 (1.06)	43.7 (1.72)	1.1 (0.04)	0.122
22.225 (0.8750)	47.625 (1.8750)	9.525 (0.3750)	0.8 (0.03)	9400	5220	15000	18000	S9	30.2 (1.19)	40.5 (1.59)	0.5 (0.02)	0.078
	50.800 (2.0000)	14.288 (0.5625)	1.6 (0.06)	12900	6800	14000	17000	LS9	29.7 (1.17)	44.5 (1.75)	1.1 (0.04)	0.125
	57.150 (2.2500)	17.463 (0.6875)	1.6 (0.06)	15330	8270	13000	15000	MS9	30.2 (1.19)	50.0 (1.97)	1.1 (0.04)	0.213
25.400 (1.0000)	50.800 (2.0000)	9.525 (0.3750)	0.8 (0.03)	10050	5900	14000	17000	S10	32.5 (1.28)	42.9 (1.69)	0.5 (0.02)	0.083
	57.150 (2.2500)	15.875 (0.6250)	1.6 (0.06)	17700	9700	12500	15000	LS10	33.3 (1.31)	50.0 (1.97)	1.1 (0.04)	0.166
	63.500 (2.5000)	19.050 (0.7500)	2.4 (0.09)	21250	11050	12000	14000	MS10	34.8 (1.37)	54.4 (2.14)	1.6 (0.06)	0.267
28.575 (1.1250)	63.500 (2.5000)	15.875 (0.6250)	1.6 (0.06)	19450	11300	12000	14000	LS11	38.1 (1.50)	56.4 (2.22)	1.1 (0.04)	0.225
	71.438 (2.8125)	20.638 (0.8125)	2.4 (0.09)	27000	14350	10500	12500	MS11	38.1 (1.50)	61.5 (2.42)	1.6 (0.06)	0.363

SINGLE ROW RADIAL BALL BEARING



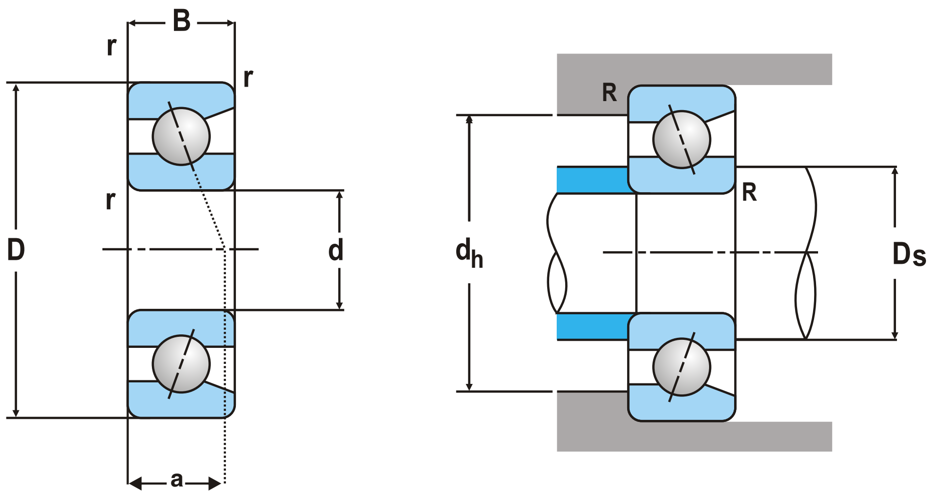


INCH SERIES

Boundary Dimensions				Basic Load Rating (N)		Limiting Speed (rpm)		Bearing Number	Abutment and Fillet Dimensions			Mass kg (Approx.)
d mm (inch)	D mm (inch)	B mm (inch)	r mm (inch)	Dynamic C	Static Co	Grease	Oil		D_s mm (inch)	d_h mm (inch)	R mm (inch)	
31.750	69.850	17.463	1.6	17800	11200	10000	13000	LS12	41.4	62.7	1.1	0.307
(1.2500)	(2.7500)	(0.6875)	(0.06)						(1.63)	(2.47)	(0.04)	
	79.375	22.225	2.4	33300	18000	9200	10500	MS12	43.7	69.1	1.6	0.480
	(3.1250)	(0.8750)	(0.09)						(1.72)	(2.72)	(0.06)	
34.925	76.200	17.463	1.6	20800	13300	10000	12000	LS12½	46.0	68.3	1.1	0.367
(1.3750)	(3.0000)	(0.6875)	(0.06)						(1.81)	(2.69)	(0.04)	
	88.900	22.225	2.4	37200	22050	8600	10000	MS12½	47.8	76.2	1.6	0.639
	(3.2500)	(0.8750)	(0.09)						(1.88)	(3.00)	(0.06)	
38.100	82.550	19.050	2.4	25700	16000	9000	10000	LS13	49.3	73.4	1.6	0.446
(1.5000)	(3.2500)	(0.7500)	(0.09)						(1.94)	(2.89)	(0.06)	
	95.250	23.813	2.4	47700	26700	8000	9500	MS13	50.8	82.6	1.6	0.761
	(3.7500)	(0.9375)	(0.09)						(2.00)	(3.25)	(0.06)	
41.275	88.900	19.050	2.4	27500	18100	8500	10000	LS13½	54.1	77.77	1.6	0.535
(1.6250)	(3.5000)	(0.7500)	(0.09)						(2.13)	(3.06)	(0.06)	
	101.60	23.813	2.4	48300	27750	7600	9000	MS13½	56.6	88.1	1.6	0.862
	(4.0000)	(0.9375)	(0.09)						(2.23)	(3.47)	(0.06)	
44.450	95.250	20.638	2.4	35000	23200	8000	9500	LS14	57.2	87.1	1.6	0.654
(1.7500)	(3.7500)	(0.8125)	(0.09)						(2.25)	(3.31)	(0.06)	
	107.95	26.988	2.4	56250	32700	7000	8300	MS14	59.4	93.7	1.6	1.084
	(4.2500)	(1.0625)	(0.09)						(2.34)	(3.69)	(0.06)	
47.625	101.60	20.638	2.4	48700	31200	7800	9200	LS14½	63.5	92.2	1.6	0.710
(1.875)	(4.0000)	(0.8125)	(0.09)						(2.50)	(3.63)	(0.06)	
	114.30	26.988	2.4	62100	38500	6700	8000	MS14½	65.0	100.1	1.6	1.240
	(4.5000)	(1.0625)	(0.09)						(2.56)	(3.94)	(0.06)	
50.800	101.60	20.638	2.4	48700	31200	7800	9200	LS15	63.5	92.2	1.6	0.671
(2.0000)	(4.0000)	(0.8125)	(0.09)						(2.50)	(3.63)	(0.06)	
	114.30	26.988	2.4	62100	38500	6700	8000	MS15	65.0	100.1	1.6	1.189
	(4.5000)	(1.0625)	(0.09)						(2.56)	(3.94)	(0.06)	

NBC BEARINGS

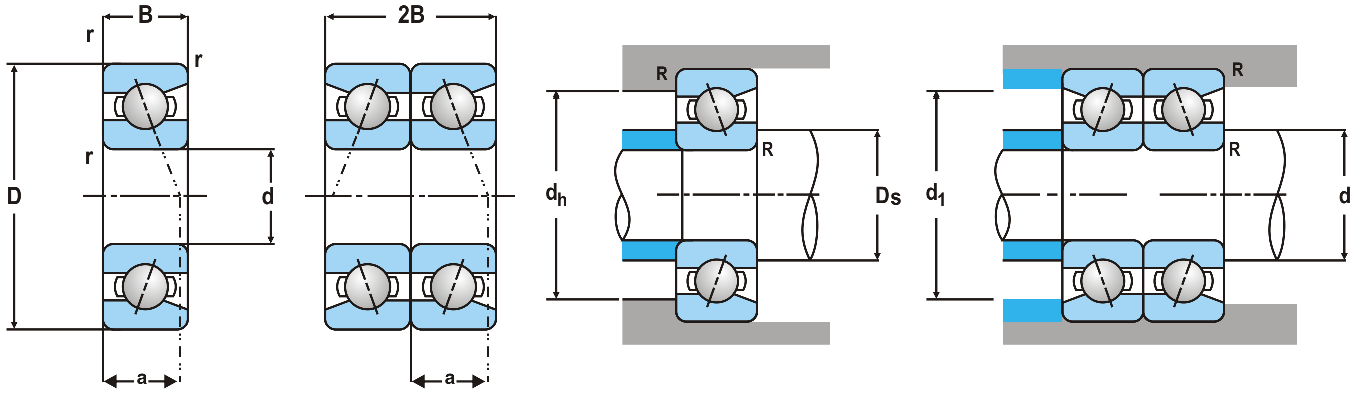
SINGLE ROW ANGULAR CONTACT BALL BEARING



METRIC SERIES

Boundary Dimensions (mm)				Basic Load Rating (N)		Limiting Speed (rpm)		Bearing Number	Abutment and Fillet Dimensions			Load Center	Mass Kg. (Approx.)
d	D	B	r min.	Dynamic C	Static Co	Grease	Oil		D_s max.	d_h min.	R max.	a	
17	40	12	1.0	9700	5380	15000	21000	7203	22	35	1.0	14.5	0.064
20	47	14	1.0	12700	7540	14000	18000	7204	26	41	1.0	17	0.100
35	72	17	2.0	29700	20050	8600	11000	7207	42	65	1.0	24	0.281
40	90	23	2.0	44250	29740	6900	9200	7308	48.5	81.5	1.0	30.5	0.625
45	120	29	2.0	80200	53650	4500	5800	7409	60	100	1.0	55.8	1.83
50	110	27	2.0	59180	45000	5600	7500	7310	60	100	1.0	36.5	1.09
60	110	22	2.0	45500	39300	5300	7000	7212	68.5	101.5	1.0	36	0.765

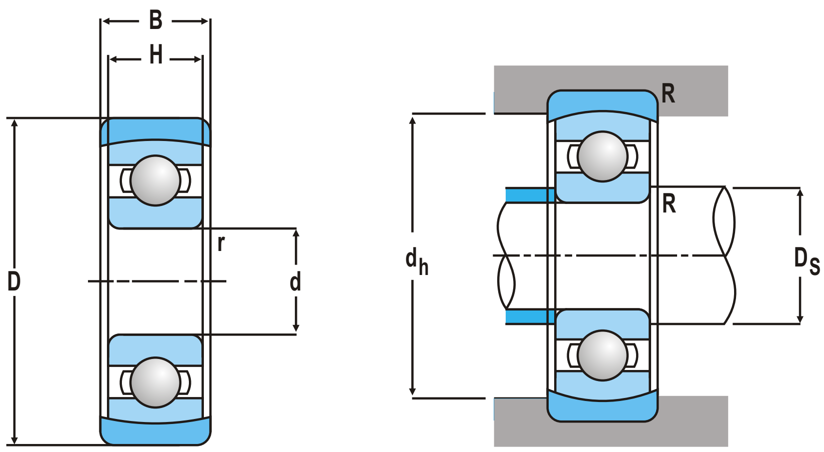
SINGLE ROW ANGULAR CONTACT BALL BEARING



INCH SERIES

Boundary Dimensions d mm (inch)	D mm (inch)	B mm (inch)	r mm (inch)	Basic Load Rating (N) Dynamic C	Static Co	Limiting Speed (rpm) Grease	Oil	Bearing Number	Abutment and Fillet Dimensions D_s mm (inch)	d_h mm (inch)	d_1 mm (inch)	R mm (inch)	Load Center a mm (inch)	Mass kg (Approx.)
82.550 (3.500)	152.40 (6.0000)	26.988 (1.0625)	2.4 (0.09)	88400	80100	2600	3500	LS19½ ACD	100.0 (3.94)	134.0 (5.28)	- -	2.0 (0.08)	73.6 (2.90)	2.27
	152.40 (6.000)	53.975 (2.125)	2.4 (0.09)	176800	155800	2600	3500	N4711C	100.0 (3.94)	140.0 (5.51)	- -	2.0 (0.08)	73.6 (2.90)	4.54

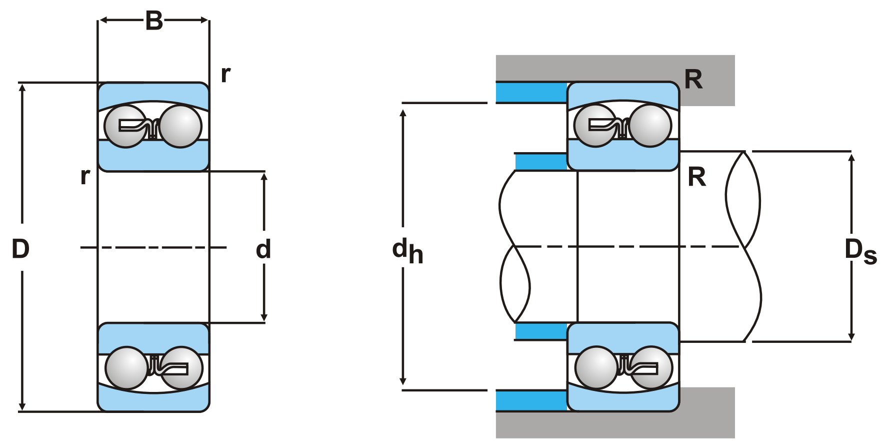
SINGLE ROW EXTERNALLY ALIGNING BALL BEARING



INCH SERIES

Boundary Dimensions d mm (inch)	D mm (inch)	B mm (inch)	H mm (inch)	r mm (inch)	Basic Load Rating (N) Dynamic C	Static Co	Limiting Speed (rpm) Grease	Oil	Bearing Number	Abutment and Fillet Dimensions D_s mm (inch)	d_h mm (inch)	R mm (inch)	Mass kg (Appr.)
44.45 (1.7500)	11.7475 (4.6250)	28.575 (1.1250)	26.988 (1.0625)	2.4 (0.09)	56250	32700	6500	900	MSN14	59.4 (2.34)	110.0 (4.33)	1.6 (0.06)	1.70

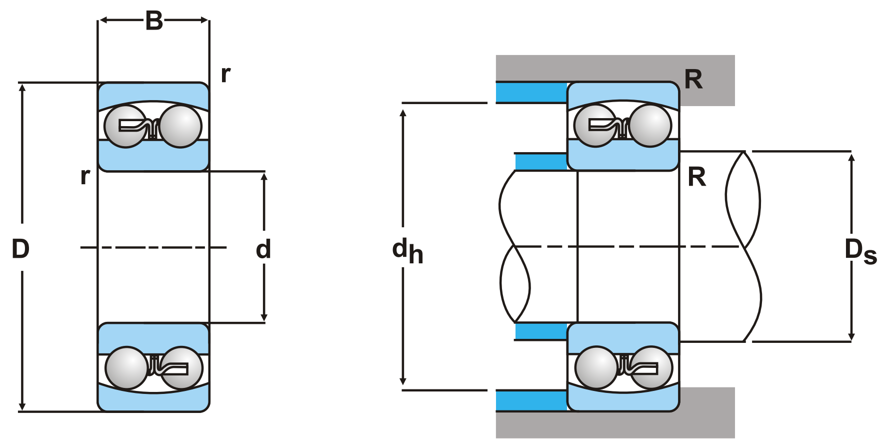
DOUBLE ROW SELF ALIGNING BALL BEARING



METRIC SERIES

Boundary Dimensions (mm)				Basic Load Rating (N)		Limiting Speed (rpm)		Bearing Number	Abutment and Fillet Dimensions			Mass Kg. (Approx.)
d	D	B	r min.	Dynamic C	Static Co	Grease	Oil		D_s max.	d_h min.	R max.	
17	40	12	0.6	7900	2010	14000	17000	1203	21	36	0.6	0.072
25	62	17	2.0	17250	5040	9100	11000	1305	32	55	1.0	0.263
25	52	15	1.0	12100	3300	11000	13000	1205	30	47	1.0	0.138
30	62	16	1.0	15600	4650	9200	11000	1206	36	56	1.0	0.231
30	72	19	2.0	20750	6300	7700	9100	1306	37	65	1.0	0.395
40	80	18	2.0	19700	6700	7100	8400	1208	47	73	1.0	0.417
45	85	19	2.0	21900	7350	6400	7500	1209	52	78	1.0	0.481
55	100	21	2.0	26800	10000	5300	6200	1211	63.5	91.5	1.5	0.703
75	130	25	2.0	38700	16000	3900	4600	1215	83.5	121.5	1.5	1.460

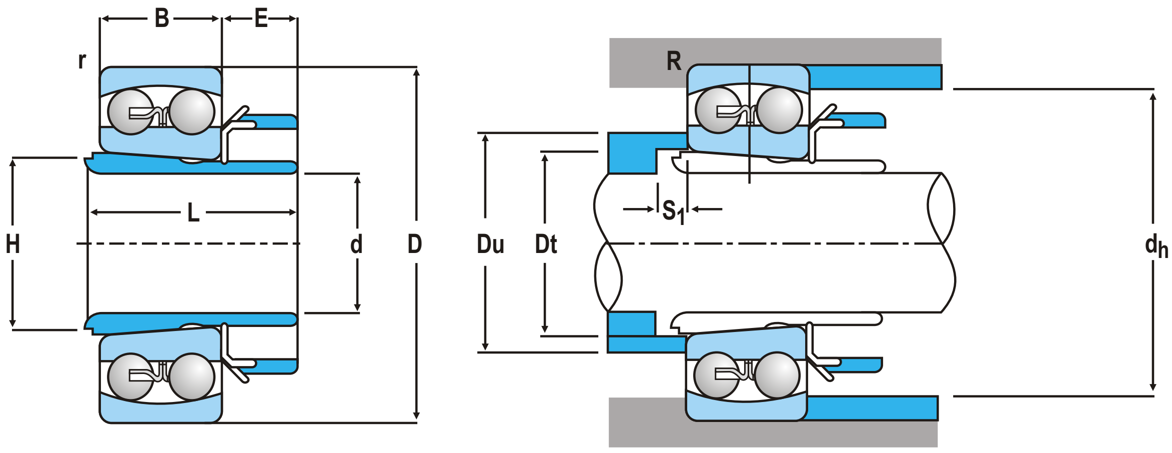
DOUBLE ROW SELF ALIGNING BALL BEARING



INCH SERIES

Boundary Dimensions				Basic Load Rating (N)		Limiting Speed (rpm)		Bearing Number	Abutment and Fillet Dimensions			Mass kg (Approx.)
d mm (inch)	D mm (inch)	B mm (inch)	r mm (inch)	Dynamic C	Static Co	Grease	Oil		D_s mm (inch)	d_h mm (inch)	R mm (inch)	
31.750 (1.250)	69.850 (2.750)	17.460 (0.688)	1.6 (0.06)	19150	5750	10700	14500	ULS12V	45.0 (1.77)	61.2 (2.41)	1.6 (0.06)	0.324

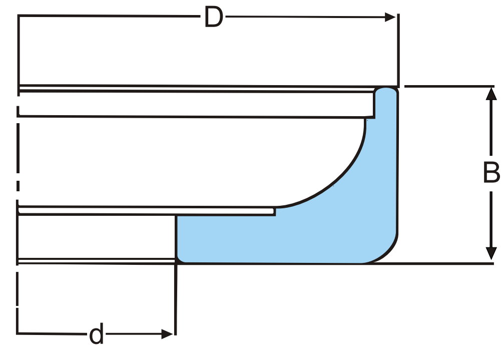
DOUBLE ROW SELF ALIGNING BALL BEARINGS WITH TAPER CLAMPING SLEEVE AND NUT



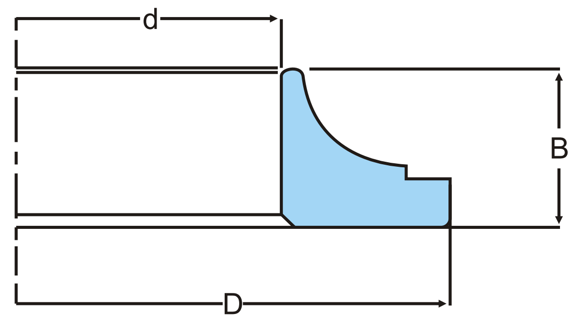
METRIC SERIES

Boundary Dimensions (mm)							Basic Load Rating (N)		Limiting Speed (rpm)		Bearing Number	Abutment and Fillet Dimensions					Mass Kg. (Approx.)
d	D	B	L	E	H	r	Dynamic C	Static Co	Grease	Oil		D_t min.	D_u max.	d_h min.	S_1 max.	R max.	
20	52	15	26	8.0	26.00	1.0	12100	3300	11000	13000	1205K	28	33	46	5	0.5	0.250
25.4	62	16	34	11.2	30.96	1.0	15600	4650	9200	11000	1206K	35	39	56	9	0.5	0.347
31.75	80	18	38	12.4	40.08	2.0	19700	6550	7100	8400	1208K	46	52	70	10	1.0	0.680
38.10	85	19	40	12.4	46.83	2.0	21900	7350	6400	7500	1209K	54	57	75	11	1.0	0.753
50.80	100	21	46	13.6	57.15	2.0	26800	10000	5300	6200	1211K	63	69	88	13.5	1.0	1.080
63.50	130	25	56	15.3	76.71	2.0	38700	16000	3900	4600	1215K	81	93	118	18	1.0	2.354

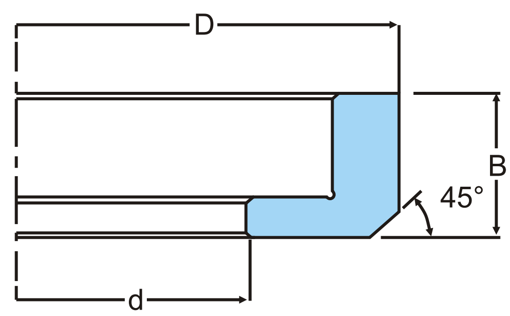
SPECIAL BEARING RACES



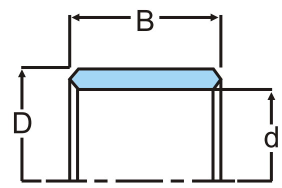
	d	D	B
BB1006	27	45	10.5
BB1030	27.8	46.2	8
BB1031	27.8	47.2	8



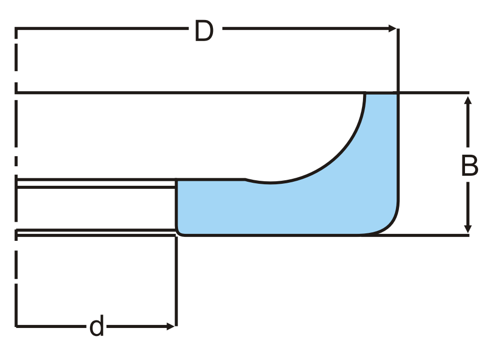
	d	D	B
BB1007	24.2	39	8.65
BB1058	25.0	48	5.5
BB1059	30.0	48	5.5



	d	D	B
BB1008	32	42.3	8



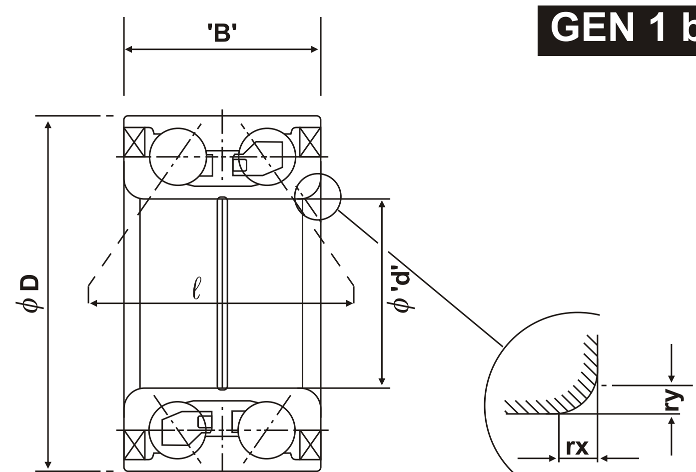
	d	D	B
BB1009	17.04	20.05	14.1
RB5005	22.03	28.0	12.0
RB5003	23.29	31.79	9.63
RB5004	38.10	47.63	19.18



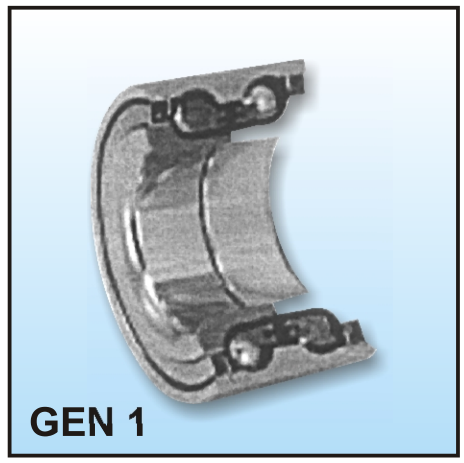
	d	D	B
BB1060	31	48	5.5
BB1061	26	48	5.5

Double Row Angular Contact Sealed Bearings (Wheel Application)

GEN 1 ball type



Type with integrated seal



Main dimensions (mm)					Distance between pressure cone appexes 1 (mm)	Bearing No.	Basic load rating (kN) Double row		Mass (kg) (Approx.)
D	D	B	rx(min.)	Ry(min.)			C Dynamic	Co Static	
25	52	42	3.5	3.5	50.6	AU1102-2LLX2	31.0	25.5	0.36
35	61.8	40	3.5	3.5	54.7	AU1103-2LLX2	35.0	34.0	0.43
	68	37	3.5	3.5	52.6	AU1101-2LLX2	45.9	43.1	0.56
36	68	33	3.5	3.5	52.6	BB1066-2LLX2	45.9	43.1	0.49

Lubrication

The objective of lubrication is to form a film of oil on rolling or sliding surface to prevent the metals from making direct contact with each other, Lubrication has the following effects :

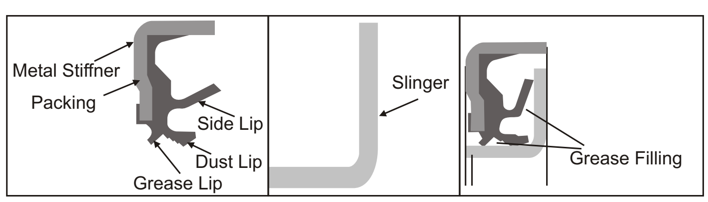
1. Reduces friction and wear.
2. Extends Bearing life.
3. Prevents rusting.
4. Prevents penetration of foreign matter.

Fretting wear particularly tends to occur on the raceway of DRAC Bearing during transport of finished automobiles. Therefore the fretting resistance property of Lubricant should be taken into account while selecting lubricant for DRAC Bearings.

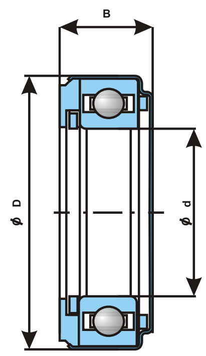
Characteristics	Resists fretting, enhances protection against rust
Maker	Nippon Oil Japan
Name	PYRONOC Universal N6B/N6C
Thickener	Urea
Base Oil	Mineral Oil
Working Temperature	-30 to 150 C
Colour	Cream
Remarks	Fretting Resistance Excellent Recommended grease for Passenger Cars

Seals

A special Low torque high performance (LTHP) seal on both sides of the DRAC Bearing prevent water ingress in the bearing and have low torque. It consists of 3-lips - Grease Lip, Dust Lip and Side Lip. A stainless Steel Slinger is added to the 3-lip seal sliding part, which dramatically enhances rust resistance of the sliding part of the lips. Side lip is added for improving the sealing performance.

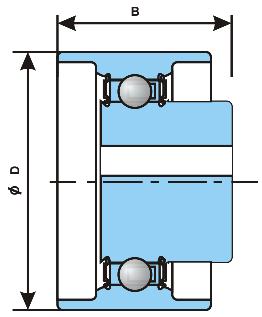


Clutch Release Bearing



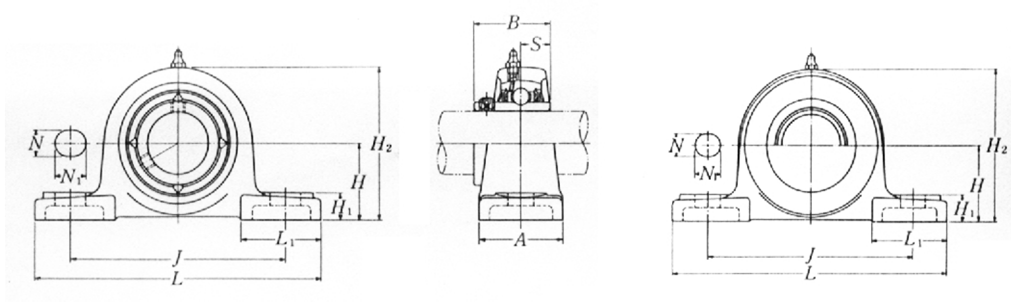
Bearing No.	Boundary Dimensions			Basic Load Rating (N)	
	d	D	B	Dynamic C	Static Co
1888180	50	91.6	29	35000	23200
1888451	45	86.6	28	32700	20500
306445C	50	81.6	25	21800	16600

Belt Tensioners



Bearing No.	Boundary Dimensions			Basic Load Rating (N)	
	d	D	B	Dynamic C	Static Co
JPU51-15	-	51	30.4	9400	5050
BB1079	-	51	32	10100	5850

Pillow blocks cast housing
Set screw type

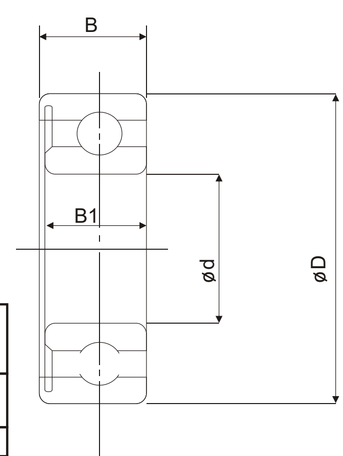


Shaft Dia	Unit No.	H	L	J	A	N	N_1	H_1	H_2	L_1	B	S	BOLT SIZE	Bearing No.
25	UCP20SDI	36.5	140	105	38	13	16	15	71	42	34.1	14.3	M10	UC 205 D_1

SINGLE ROW RADIAL BALL BEARING (SPECIAL BEARING)

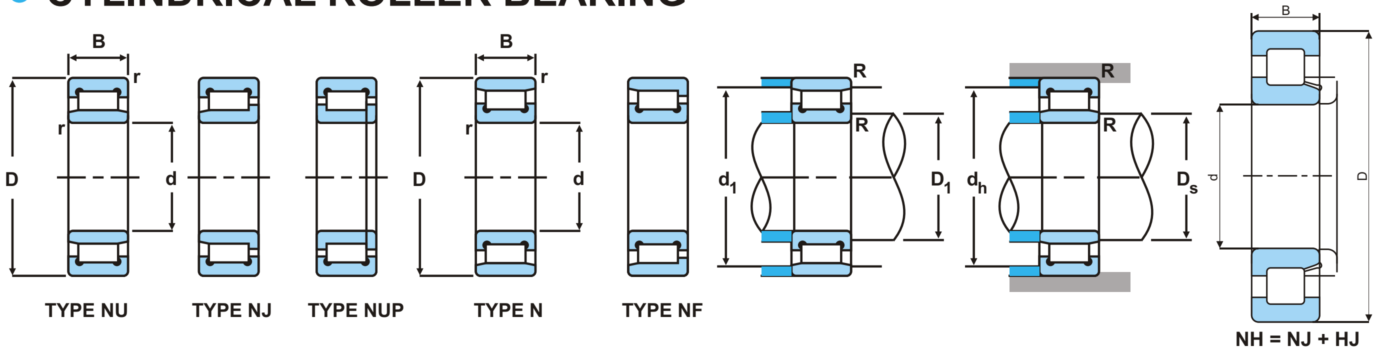
METRIC SERIES

Boundary Dimension (mm)					Basic Load Rating (N)		Limiting Speed (rpm)		Bearing Numbrt	Abutment and Fillet Dimensions		
d	D	B	B_1	r (min.)	Dynamic C	Static Co	Grease	Oil		Ds max.	dh min.	R max.
35	72	18.5	15	-	25700	15400	9800	11000	BB1103	45	65.5	1.5
22	22	18.5	15	-	20700	10400	14000	17000	63/22SPL	31	50	1.5



METRIC SERIES

CYLINDRICAL ROLLER BEARING



Straight Roller Bearing sizes

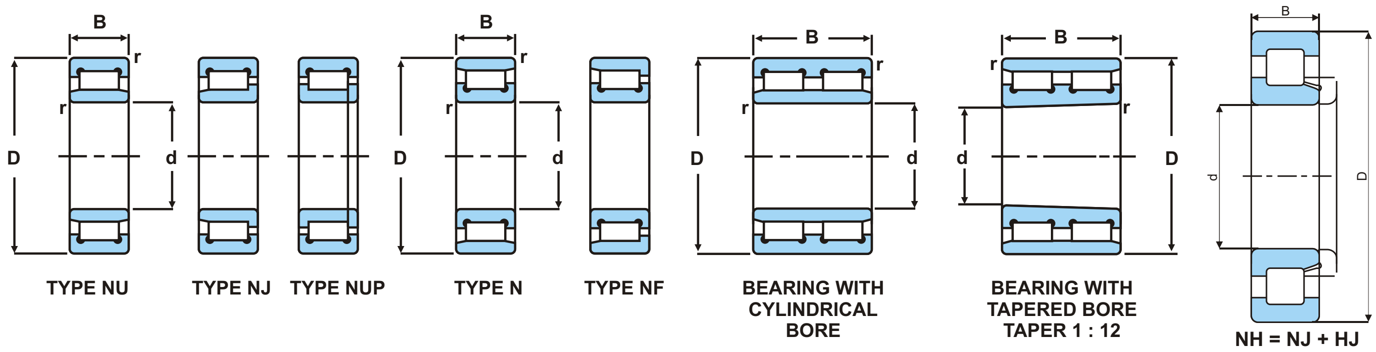
						RPM		Bearing No.	Abutment					
d	D	B	r	C	Co	Grease	Oil		Ds	D1	Dh	d1	R	Mass
25	62	17	1.1	31500	27700	12000	14000	NJ305	37.5	-	55.5	-	1.1	0.24
30	58	17	1.5	33500	39000			30X58X17	-	-	-	-	1.5	
22	58	17	1.5	33500	39000			22X58X17	-	-	-	-	1.5	
45	100	25	1.5	97500	98500	6500	7600	NU309E	53	-	92	-	1.5	0.89
45	100	25	1.5	97500	98500	6500	7600	NU309EN	53	-	92	-	1.5	0.89

METRIC SERIES

Boundary Dimensions (mm)				Basic Load Rating (N)		Limiting Speed (rpm)		Bearing Number	Abutment and Fillet Dimensions					Approx. mass (Kg.)
d	D	B	r	Dynamic C	Static Co	Grease	Oil		D_s	D_1	d_h	d_1	R	
22	58	17	1.5	33500	39000			22X58X17	-	-	-	-	1.5	0.240
25	52	15	1.0	29300	27700	13000	15000	NU205E	29	-	47	-	1.0	0.130
	62	17	1.1	31500	27700	12000	14000	NU305	31.5	-	55.5	-	1.1	0.230
	62	17	1.5	50000	48000	4000	5000	NJK305*	37.5	-	55.5	-	1.5	0.245
	62	17	1.1	31500	27700	12000	14000	NJ305	37.5	-	55.5	-	1.1	0.24
30	58	17	1.5	33500	39000			30X58X17	-	-	-	-	1.5	0.19
35	80	21	1.5	49500	47000	9000	11000	N307	-	43	-	73.5	1.0	0.464
	80	23	-	76000	83000	8100	9600	NU307ENS	41.5	-	72	-	1.5	0.570
40	80	18	1.1	43800	43000	9400	11000	N208	46.5	46.5	73.5	-	1.1	0.372
	80	18	1.1	55500	55500	8500	15000	NUP208E	46.5	-	73.5	-	1.1	0.384
	90	23	1.5	72000	71000	8000	9400	N308	-	48	-	82	1.5	0.643
45	85	23	1.1	84000	96000	6800	8000	NU2209EN	52.5	-	78.5	-	1.0	0.540
	100	25	1.5	79000	77500	7200	8400	NU309	54	-	82	-	1.5	0.857
	100	25	1.5	79000	77500	7200	8400	NU309N	54	-	82	-	1.5	0.845
	100	25	1.5	79000	77500	7200	8400	NF309	54	-	82	-	1.5	0.870
	100	25	1.5	79000	77500	7200	8400	NJ309	54	-	82	-	1.5	0.886
	100	25	1.5	79000	77500	7200	8400	NUP309N	54	-	82	-	1.5	0.898
	100	25	1.5	97500	98500	6500	7600	NU309E	53	-	92	-	1.5	0.89
	100	25	1.5	97500	98500	6500	7600	NU309EN	53	-	92	-	1.5	0.89
50	90	23	1.1	67500	78500	6900	8100	NH2210	56.5	56.5	83.5	-	1.1	0.648
	110	27	2.0	87000	86000	6500	7700	NUP310N	59	59	101	-	1.5	1.186
	110	27	2.0	87000	86000	6500	7700	NU310	59	59	101	-	1.5	1.19
	110	27	2.0	87000	86000	6500	7700	NJ310	59	59	101	-	1.5	1.140
55	100	21	1.1	61000	66500	6900	8200	NU211	61.5	-	92	-	1.1	0.638
	100	21	1.1	61000	66500	6900	8200	NJ211	61.5	61.5	92	-	1.1	0.652

*Full complement Roller Bearing

CYLINDRICAL ROLLER BEARING

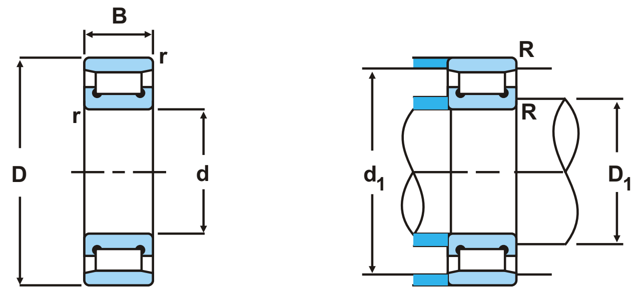


TYPE NU TYPE NJ TYPE NUP TYPE N TYPE NF BEARING WITH CYLINDRICAL BORE BEARING WITH TAPERED BORE TAPER 1 : 12 NH = NJ + HJ

METRIC SERIES

Boundary Dimensions (mm)				Bearing Number	Basic Load Rating (N)		MASS Kg (Approx.)
d	D	B	r		Dynamic C	Static Co	
120	215	58	3.5	NJ2224	366960	496200	8.76
130	230	79.4	5.0	NU5226M	525400	776100	14.00
130	250	80	4.0	RB5054	524300	746700	18.90
130	250	80	4.0	RB5055	524300	746700	18.90
150	270	88.9	6.0	NU5230M	728800	1103900	22.00
170	360	72	5.0	N334	800000	1020000	38.70
180	320	108	3.0	NU5236M	987900	1552600	37.00
180	380	75	5.0	NJ336	882800	1123200	44.20
200	360	120.65	8.0	NU5240	1337000	2229000	53.70
220	400	65	5.0	NJ244	763200	1086200	38.00
220	400	108	5.0	NU2244	1156000	1852700	59.00
220	340	56	3	NH1044	500000	750000	20.98
220	350	98.4	2.5	6943	953500	1649000	35.00
260	400	65	5.0	NJ1052	790900	1159230	30.90
260	400	65	5.0	NUP1052	790900	1159230	31.70
280	380	100	3.5	NNU4956	697800	908000	31.70
280	500	165.1	3.6	NU5256	2915500	5238800	139.0
320	440	56	3	NU1964	625000	1100000	25.31
320	480	121	5.0	NN3064K	1349700	2662800	74.00
400	650	145	8.0	2032780	2544200	4550000	196.0
460	680	218	8.0	4202192	3750000	8560000	269.0
469.9	698.5	139.7	6.0	N1050	3300000	6180000	190.0
530	710	180	6.0	42629/530	3244000	8129200	220.0
600	830	150	6.0	327/600	2917300	6156500	245.0
670	980	308	10.0	N1009	7120000	10000000	780.0
700	930	160	8.0	327/700	2972800	6902500	300.0

CYLINDRICAL ROLLER BEARING



TYPE N

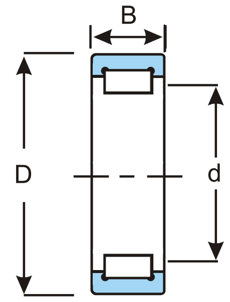
INCH SERIES

Boundary Dimensions				Basic Load Rating (N)		Limiting Speed (rpm)		Bearing Number	Abutment and Fillet Dimensions					Mass kg (Approx.)
d mm (inch)	D mm (inch)	B mm (inch)	r mm (inch)	Dynamic C	Static Co	Grease	Oil		D_s	D_1	d_h	d_1	R max.	
25.40 (1.000)	57.150 (2.250)	15.875 (0.625)	1.07 (0.04)	31300	27300	12000	14000	RLS10	-	35.0 (1.378)	-	50.0 (1.378)	1.0 (0.04)	0.176

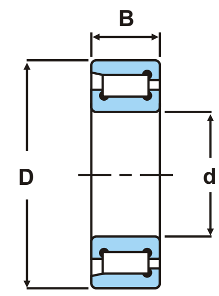
NBC BEARINGS

SPECIAL BEARING ROLLER BEARING

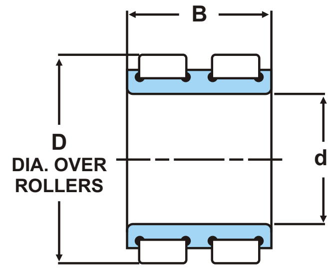
BRG NO.	d mm (Inch)	D mm (Inch)	B mm (Inch)
L3782	26.993 (1.0627)	50.782 (1.9993)	17.4625 (0.6875)



BRG NO.	d mm (Inch)	D mm (Inch)	B mm (Inch)
N-1004	31.75 (1.25)	79.350 (3.124)	22.225 (0.875)

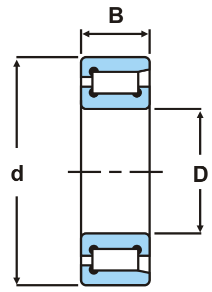


BRG NO.	d mm (Inch)	D mm (Inch)	B mm (Inch)
L064	25.400 (1.000)	53.967 (2.1274)	28.575 (1.125)



NBC BEARINGS

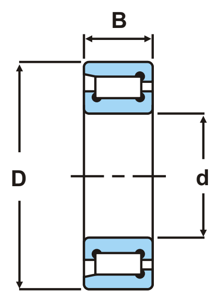
SPECIAL CYLINDRICAL ROLLER BEARING



Boundary Dimensions (mm)			Bearing Number	Basic Load Rating (N)	
d	D	B		Dynamic C	Static Co
90	190	43	L5285	244000	269400
116	220	60	RB5034	374000	539900
118	220	60	RB5002	374000	539900
120	215	60	L6180	374000	539900
	220	60	L5064	374000	539900
	240	80	WJP120 x 240P	550900	738100
128	260	84	RB5066	614500	837200
130	240	80	WJP130 x 240P	480900	668600
	240	80	WJP130 x 240PE	524300	746700
	260	84	L5944	615400	837200
144.5	245	72	RB5024	491000	721800
	245	80	RB5047	544300	831300
148	270	80	RB5044	637500	926100
150	270	80	L6205	637500	926100
	300	102	WJP130 x 300P	960100	1373700
158	318	98	RB5068	887000	1220800
160	318	98	L5946	887000	1220800
Boundary Dimensions mm (Inch)			Bearing Number	Basic Load Rating (N)	
107.95	203.20	57.15	L6029	356600	469200
(4.250)	(8.000)	(2.250)			
139.70	254.00	71.438	L6031	553700	745300
(5.500)	(10.000)	(2.8125)			

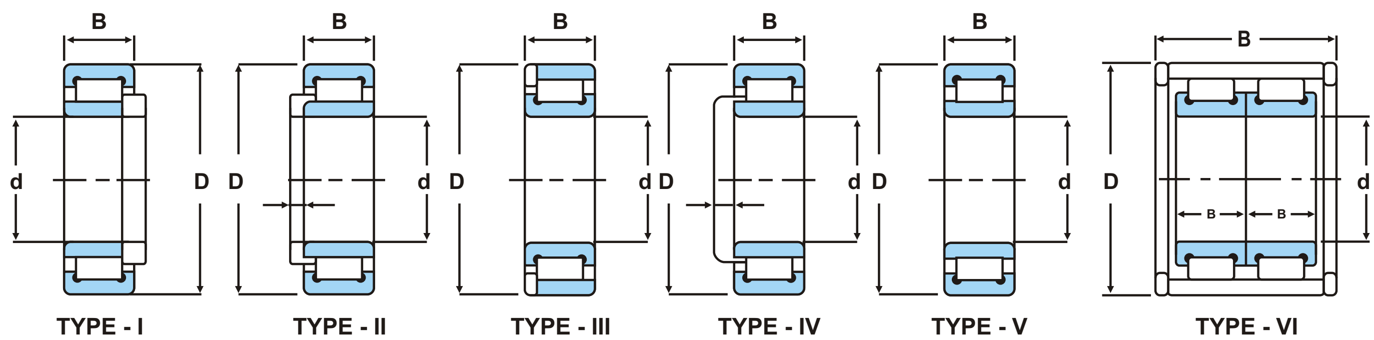
NBC BEARINGS

SPECIAL CYLINDRICAL ROLLER BEARING



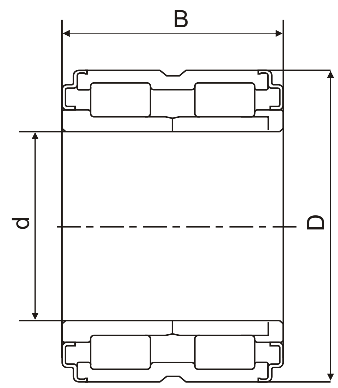
Boundary Dimensions (mm)			Bearing Number	Besic Load Rating (N)	
d	D	B		Dynamic C	Static Co
116	220	60	RB5033	374000	539900
118	220	60	RB5001	374000	539900
120	215	60	L6179	374000	539900
	220	60	L5063	374000	539900
	240	80	WJP120 x 240P	550900	738100
126	240	80	RB5006	480900	837200
	240	80	RB5058	524300	668600
128	240	80	NBR102	480900	746700
	240	80	RB5056	524300	837200
	260	84	RB5065	614500	721800
130	240	80	WJP130 x 240	480900	831300
	240	80	WJP130 x 240E	524300	926800
	260	84	L5943	615400	926800
140	250	68	RB5017	459170	1373700
144.5	245	72	RB5023	491000	1220800
	245	80	RB5046	544300	1220800
148	270	80	RB5043	637500	926100
150	270	80	L6204	637500	926100
	300	102	WJP130 x 300	960100	1373700
158	318	98	RB5067	887000	1220800
160	318	98	L5945	887000	1220800
Boundary Dimensions mm (Inch)			**Bearing Number**	**Besic Load Rating (N)**	
107.95 (4.250)	203.20 (8.000)	57.15 (2.250)	L6028	356600	469200
139.70 (5.500)	254.00 (10.000)	71.438 (2.8125)	L6030	553700	745400

SPECIAL CYLINDRICAL ROLLER BEARING



Boundary Dimensions (mm)			Bearing Number	Type	Besic Load Rating (N)	
d	D	B			Dynamic C	Static Co
100	215	-	L4430	II	298700	3314500
126	240	85	RB5059	I	524300	746700
128	240	85	NBR101	I	480900	668600
128	240	85	RB5007	I	480900	668600
128	240	85	RB5057	I	524300	746700
130	240	85	WJP130 x 240P	I	480900	668600
			with spl. loose lip L5032			
130	240	85	WJP130 x 240PE	I	524300	746700
130	280	-	L5284	V	628000	753460
140	250	68	RB5018	II	459200	657900
148	270	80	RB5062	V	637500	926100
148	270	80	RB5063	IV	637500	926100
148	270	80	RB5064	IV	637500	926100
150	270	80	RB5020	V	637500	926100
150	270	80	RB5021	IV	637500	926100
150	270	80	RB5022	IV	637500	926100
150	320	-	L4023	V	-	-
200	360	236	L6207	VI	1567500	2741500
200	360	-	L6019	III	906400	1370800

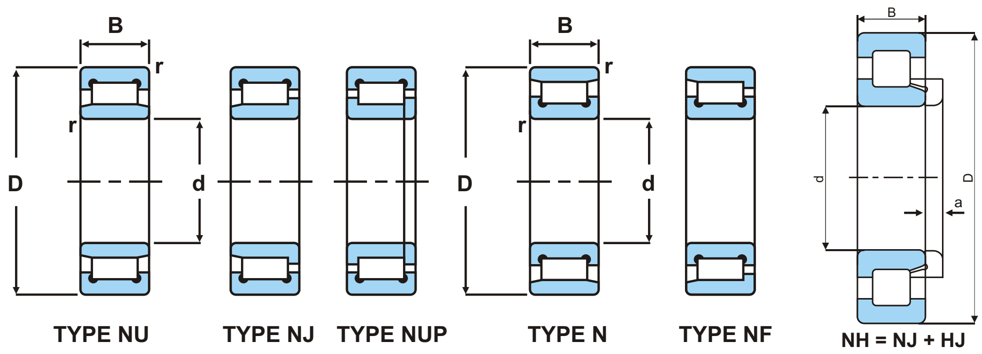
DOUBLE ROW CYLINDRICAL ROLLER SEALED UNIT



TYPE - VII

Boundary Dimensions (mm)			Bearing Number	Type	Besic Load Rating (N)	
d	D	B			Dynamic C	Static Co
150	250	180	RB 5080	VII	1183500	1800000
150	270	210	RB5081	VII	1340000	1980000

SPECIAL CYLINDRICAL ROLLER BEARING

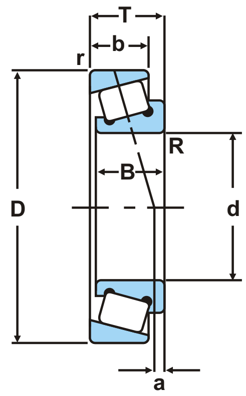


FOR TRACTION MOTOR APPLICATION

Boundary Dimensions (mm)				Bearing Number	Basic Load Rating (N)	
d	D	B	a		Dynamic C	Static Co
90	190 190 190	43 43 43	12 - -	NH318 NUP318 NU318	240000	265000
100	215 215 215	47 47 47	- 13 -	NU320 NH320 * NJ320	380000	425000
120	260 260 260	55 55 55	14 - -	NH324 NJ324 NU324	475000	55000
130	280	58	-	NU326	560000	665000
			15			
140	300	62	-	NU328	665000	745000
150	320	65	-	NU330 *	800000	985000
180	380	75	-	NU336	905000	1150000

1. All Bearings are made with Riveted Brass Cage.
2. * Marked bearings are also available with Rivetless Brass Cage.

SINGLE ROW TAPERED ROLLER BEARING

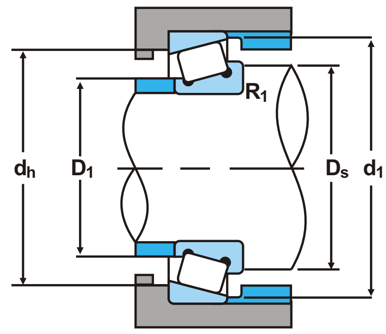


SINGLE ROW TYPE
INCH SERIES

Boundary Dimensions							Basic Load Rating (N)		Limiting Speed (rpm)		Bearing Number	
d mm (inch)	D mm (inch)	T mm (inch)	B mm (inch)	b mm (inch)	R mm (inch)	r mm (inch)	Dynamic C	Static Co	Grease	Oil	Cone	Cup
15.875 (0.6250)	42.862 (1.6875)	14.288 (0.5625)	14.288 (0.3750)	9.525 (0.3750)	1.5 (0.06)	1.5 (0.06)	17700	17800	8700	112000	11590	11520
17.462 (.6875)	39.878 (1.5700)	13.843 (0.5450)	14.605 (0.5750)	10.668 (0.4200)	1.3 (0.05)	1.3 (0.05)	22400	23000	9000	13000	LM11749	LM11710
19.050 (0.7500)	45.237 (1.7810)	15.494 (0.6100)	16.637 (0.6650)	12.065 (0.4750)	1.3 (0.05)	1.3 (0.05)	29000	29500	8900	12000	LM11949	LM11910
	49.225 (1.9380)	18.034 (0.7100)	19.050 (0.7500)	14.288 (0.5625)	1.3 (0.05)	1.3 (0.05)	40100	41700	8000	11000	M12644	M12611
21.430 (0.8437)	50.005 (1.9687)	17.526 (0.6900)	18.288 (0.7200)	13.970 (0.5500)	1.3 (0.05)	1.3 (0.05)	40100	41700	8000	11000	M12649	M12610
25.00 (0.9843)	62.000 (2.4410)	20.638 (0.8125)	20.638 (0.8125)	15.875 (0.6250)	1.3 (0.05)	1.5 (0.06)	41700	46900	6100	8200	N1005	N1005
25.400 (1.0000)	63.500 (2.5000)	20.638 (0.8125)	20.638 (0.8125)	15.875 (0.6250)	1.3 (0.05)	1.5 (0.06)	48400	57000	6100	8200	15100S	15250X
	62.000 (2.4410)	19.050 (0.8750)	20.638 (0.8125)	14.288 (0.5625)	1.3 (0.05)	1.3 (0.05)	48400	57000	6100	8200	15100S	15245
	65.088 (2.5625)	22.225 (0.8750)	21.463 (0.8450)	15.875 (0.6250)	1.5 (0.06)	1.5 (0.06)	44700	47400	5700	7600	23100	23256
26.988 (1.0625)	50.292 (1.9800)	14.224 (0.5600)	14.732 (0.5800)	10.668 (0.4200)	3.5 (0.14)	1.3 (0.05)	27400	31800	7400	9900	L44649	L44610
28.575 (1.1250)	57.150 (2.2500)	19.845 (0.7813)	19.355 (0.7620)	15.875 (0.6250)	3.5 (0.14)	1.5 (0.06)	46100	53000	6700	8900	1988	1922
	62.000 (2.4410)	18.161 (0.7150)	19.050 (0.7500)	14.288 (0.5625)	3.5 (0.14)	1.3 (0.05)	48400	57000	6100	8200	15112R	15245
	73.025 (2.8750)	22.225 (0.8750)	22.225 (0.8750)	17.462 (0.6875)	0.8 (0.03)	3.3 (0.13)	60100	73700	5300	7000	02872	02820
29.985 (1.1805)	62.0000 (2.4410)	19.050 (0.7500)	20.638 (0.8125)	14.288 (0.5625)	1.3 (0.05)	1.3 (0.05)	48400	57000	6100	8200	15117	15245

NBC BEARINGS

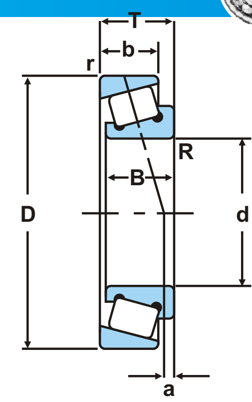
SINGLE ROW TAPERED ROLLER BEARING



INCH SERIES

Bearing Number		Abutment and Fillet Dimensions						Load Centre	Mass (Approx.)
Cone	Cup	Ds mm (inch)	D1 mm (inch)	dh mm (inch)	d1 mm (inch)	R1 mm (inch)	r1 mm (inch)	a mm (inch)	Kg (lb)
11590	11520	24.5 (0.96)	22.5 (0.89)	34.5 (1.36)	39.5 (1.56)	1.5 (0.06)	1.5 (0.06)	1.2 (0.05)	0.101 (0.223)
LM11749	LM11710	23.0 (0.91)	21.5 (0.85)	34.0 (1.34)	37.0 (1.46)	1.3 (0.05)	1.3 (0.05)	5.3 (0.21)	0.081 (0.179)
LM11949	LM11910	25.0 (0.98)	23.5 (0.93)	39.5 (1.56)	41.5 (1.63)	1.3 (0.05)	1.3 (0.05)	5.6 (0.22)	0.119 (0.262)
M12644	M12611	27.5 (1.08)	25.4 (1.00)	44.0 (1.73)	46.0 (1.81)	1.3 (0.05)	1.3 (0.05)	6.4 (0.25)	0.185 (0.408)
M12649	M12610	27.5 (1.08)	25.4 (1.00)	44.0 (1.73)	46.0 (1.81)	1.3 (0.05)	1.3 (0.05)	6.4 (0.25)	0.166 (0.366)
N1005	N1005	32.0 (1.26)	32.0 (1.26)	55.0 (2.17)	57.0 (2.24)	1.3 (0.05)	1.5 (0.06)	6.4 (0.25)	0.327 (0.721)
15100S	15250X	33.5 (1.32)	31.5 (1.24)	55.0 (2.17)	59.0 (2.32)	1.3 (0.05)	1.5 (0.06)	6.0 (0.24)	0.225 (0.496)
15100S	15245	36.5 (1.44)	35.0 (1.38)	55.0 (2.17)	58.0 (2.28)	1.3 (0.05)	1.3 (0.05)	6.0 (0.24)	0.299 (0.659)
23100	23256	39.0 (1.54)	34.6 (1.36)	53.0 (2.09)	61.0 (2.24)	1.5 (0.06)	1.5 (0.06)	2.0 (0.08)	0.356 (0.785)
L44649	L44610	37.5 (1.48)	31.0 (1.22)	44.5 (1.75)	47.0 (1.85)	3.5 (0.14)	1.3 (0.05)	3.4 (0.14)	0.117 (0.258)
1988	1922	39.5 (1.56)	33.5 (1.32)	51.0 (2.01)	53.5 (2.11)	3.5 (0.14)	1.5 (0.06)	5.9 (0.23)	0.216 (0.476)
15112R	15245	40.0 (1.57)	34.0 (1.34)	55.0 (2.17)	58.0 (2.28)	3.5 (0.14)	1.3 (0.05)	6.0 (0.24)	0.274 (0.604)
02872	02820	37.5 (1.48)	37.0 (1.46)	62.0 (2.44)	68.0 (2.68)	0.8 (0.03)	3.3 (0.13)	3.9 (0.15)	0.477 (1.052)
15117	15245	36.5 (1.44)	35.0 (1.38)	55.0 (2.17)	58.0 (2.28)	1.3 (0.05)	1.3 (0.05)	6.0 (0.24)	0.275 (0.606)

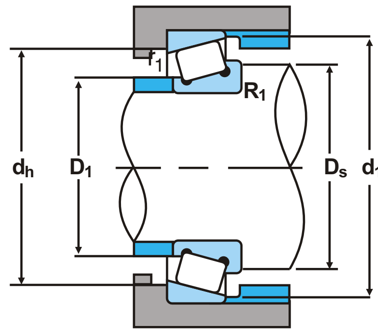
SINGLE ROW TAPERED ROLLER BEARING



INCH SERIES

Boundary Dimensions							Basic Load Rating (N)		Limiting Speed (rpm)		Bearing Number	
d mm (inch)	D mm (inch)	T mm (inch)	B mm (inch)	b mm (inch)	R mm (inch)	r mm (inch)	Dynamic C	Static Co	Grease	Oil	Cone	Cup
31.750 (1.2500)	62.000 (2.4410)	18.161 (0.7150)	19.050 (0.7500)	14.288 (0.5625)	3.5 (0.14)	1.3 (0.05)	48400	57000	6100	8200	15123	15425
	62.000 (2.4410)	19.050 (0.7500)	20.638 (0.8125)	14.288 (0.5625)	3.5 (0.14)	1.3 (0.05)	41800	47000	6100	8200	15125	15245
	68.263 (2.6875)	22.225 (0.8750)	22.225 (0.8750)	17.463 (0.6875)	3.5 (0.14)	1.5 (0.06)	50300	56700	5800	7700	02475	02420
	69.012 (0.7170)	19.845 (0.7813)	19.583 (0.7710)	15.875 (0.6250)	3.5 (0.14)	1.3 (0.05)	45100	55200	5600	7400	14125A	14276
	72.626 (2.8293)	30.162 (1.1875)	29.997 (1.1810)	28.812 (0.9375)	1.5 (0.06)	3.3 (0.13)	78000	88300	5500	7300	3188S	3120
33.338 (1.3125)	69.012 (2.7170)	19.845 (0.7813)	19.583 (0.7710)	15.875 (0.6250)	0.8 (0.03)	1.3 (0.05)	45100	55200	5500	7400	14131	14276
34.925 (1.3750)	65.088 (2.5625)	18.034 (0.7100)	18.288 (0.7200)	13.970 (0.5500)	3.5 (0.14)	1.3 (0.05)	49400	60100	5700	7600	LM48548	LM48510
	69.012 (2.7170)	19.845 (0.7813)	19.583 (0.7710)	15.875 (0.6250)	1.5 (0.06)	1.3 (0.05)	45100	55200	5600	7400	14137A	14276
	73.025 (2.8750)	23.813 (0.9375)	24.608 (0.9688)	19.050 (0.7500)	1.5 (0.06)	0.8 (0.03)	71300	85400	5300	7100	25877	25821
	73.025 (2.8750)	23.813 (0.9375)	24.608 (0.9688)	19.050 (0.7500)	1.5 (0.06)	2.3 (0.09)	71300	85400	5300	7100	25877	25820
	76.2 (3.0000)	29.370 (1.1563)	28.575 (1.1250)	23.812 (0.9375)	1.5 (0.06)	3.3 (0.13)	80300	96500	5100	6800	31594	31520
34.989 (1.3775)	79.985 (3.1490)	32.751 (1.2894)	30.925 (1.2175)	25.000 (0.9843)	2.5 (0.10)	2.5 (0.10)	86200	103500	4900	6600	3478X	3424S
38.100 (1.5000)	69.037 (2.7180)	14.427 (0.5680)	10.312 (0.4060)	12.700 (0.5000)	4.0 (0.16)	2.3 (0.09)	28800	32300	5600	7400	N1001	N1001
	79.375 (3.1250)	29.370 (1.1563)	29.771 (1.1721)	23.812 (0.9375)	3.5 (0.14)	3.3 (0.13)	86400	103800	4900	6600	3490	3420
	82.931	23.812	25.4	19.05	0.8	0.8	76000	98000	4500	6000	25572	25520
	88.500 (3.4843)	26.988 (1.0625)	29.083 (1.1450)	22.225 (0.8750)	3.5 (0.14)	1.5 (0.06)	95500	107900	4600	6100	418	414
40.988 (1.6137)	67.975 (2.6752)	17.500 (0.689)	18.000 (0.7087)	13.500 (0.5315)	3.5 (0.14)	1.5 (0.06)	45200	61300	5300	7000	LM300849X	LM300811

SINGLE ROW TAPERED ROLLER BEARING

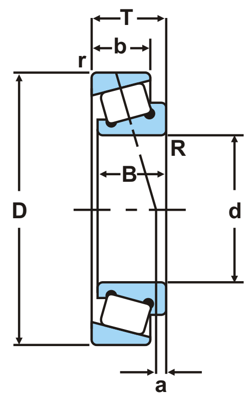


INCH SERIES

Bearing Number		Abutment and Fillet Dimensions						Load Centre	Mass (Approx.)
Cone	Cup	Ds mm (inch)	D1 mm (inch)	dh mm (inch)	d1 mm (inch)	R1 mm (inch)	r1 mm (inch)	a mm (inch)	Kg (lb)
15123	15245	42.5 (1.67)	36.5 (1.44)	55.5 (2.17)	58.0 (2.28)	3.5 (0.14)	1.3 (0.05)	5.1 (0.20)	0.225 (0.496)
15125	15245	42.5 (1.67)	36.5 (1.44)	55.0 (2.17)	58.0 (2.28)	3.5 (0.14)	1.3 (0.05)	6.0 (0.24)	0.239 (0.527)
02475	02420	44.5 (1.75)	38.5 (1.52)	59.0 (2.32)	63.0 (2.48)	3.5 (0.14)	1.5 (0.06)	5.2 (0.21)	0.379 (0.836)
14125A	14276	44.0 (1.73)	37.5 (1.48)	60.0 (2.36)	63.0 (2.48)	3.5 (0.14)	1.3 (0.05)	4.1 (0.16)	0.350 (0.772)
3188S	3120	41.5 (1.63)	39.5 (1.56)	61.0 (2.40)	67.0 (2.64)	1.5 (0.06)	3.3 (0.13)	10.1 (0.40)	0.574 (1.27)
14131	14276	39.5 (1.56)	38.5 (1.52)	60.0 (2.36)	63.0 (2.48)	0.8 (0.03)	1.3 (0.05)	4.1 (0.16)	0.334 (0.736)
LM48548	LM48510	46.0 (1.81)	40.0 (1.57)	58.0 (2.28)	61.0 (2.40)	3.5 (0.14)	1.3 (0.05)	3.7 (0.15)	0.250 (0.551)
14137A	14276	42.0 (1.65)	40.0 (1.57)	60.0 (2.36)	63.0 (2.48)	1.5 (0.06)	1.3 (0.05)	4.1 (0.16)	0.319 (0.703)
25877	25821	43.0 (1.69)	40.5 (1.59)	65.0 (2.560)	68.0 (2.68)	1.5 (0.06)	0.8 (0.03)	8.1 (0.32)	0.444 (0.979)
25877	25820	43.0 (1.69)	40.5 (1.59)	64.0 (2.52)	68.0 (2.68)	1.5 (0.06)	2.3 (0.09)	8.1 (0.32)	0.444 (0.979)
31594	31520	46.0 (1.81)	43.5 (1.71)	64.0 (2.52)	72.0 (2.83)	1.5 (0.06)	3.3 (0.13)	7.8 (0.31)	0.619 (1.36)
3478X	3424S	43.5 (2.05)	43.0 (1.69)	71.5 (2.81)	74.0 (2.91)	2.5 (0.10)	2.5 (0.10)	12.5 (0.48)	0.765 (1.69)
N1001	N1001	-	-	-	-	-	-	-	0.235 (0.518)
3490	3420	52.0 (2.05)	45.9 (1.81)	67.0 (2.64)	74.0 (2.91)	3.5 (0.14)	3.3 (0.13)	8.7 (0.34)	0.679 (1.50)
25572	25520	46	46	74	77	0.8	0.8	6.20	0.645
418	414	51.0 (2.05)	44.5 (1.75)	77.0 (3.03)	80.0 (3.15)	3.5 (0.14)	1.5 (0.06)	9.2 (0.36)	0.825 (1.82)
LM300849X	LM300811	52.0 (2.05)	45.0 (1.77)	61.0 (2.40)	65.0 (2.56)	3.5 (0.14)	1.5 (0.06)	3.6 (0.14)	0.239 (0.527)

NBC BEARINGS

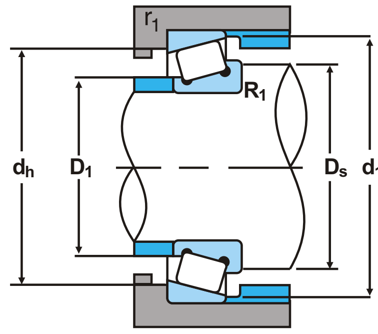
SINGLE ROW TAPERED ROLLER BEARING



INCH SERIES

Boundary Dimensions							Basic Load Rating (N)		Limiting Speed (rpm)		Bearing Number	
d mm (inch)	D mm (inch)	T mm (inch)	B mm (inch)	b mm (inch)	R mm (inch)	r mm (inch)	Dynamic C	Static Co	Grease	Oil	Cone	Cup
41.275 (1.6250)	73.025 (2.8750)	19.558 (0.7700)	19.812 (0.7800)	14.732 (0.5800)	3.5 (0.14)	1.5 (0.06)	54800	67900	5000	6600	LM501349	N1006
	73.431 (2.8910)	19.558 (0.7700)	19.812 (0.7800)	14.732 (0.5800)	3.5 (0.14)	0.8 (0.03)	54800	67900	5000	6600	LM501349	LM501310
	76.200 (3.0000)	22.225 (0.8750)	23.020 (0.9063)	17.462 (0.6875)	3.5 (0.14)	0.8 (0.03)	66200	83100	4900	6500	24780	24720
42.875 (1.6880)	82.931 (3.2650)	26.988 (1.0625)	25.400 (1.0000)	22.225 (0.8750	3.5 (0.14)	2.3 (0.09)	76700	98400	4500	6000	25577	25523
44.450 (1.7500)	95.250 (3.7500)	30.958 (1.2188)	28.875 (1.1250)	22.225 (0.8750	3.5 (0.14)	0.8 (0.03)	97700	118500	3700	4900	HM903249	HM903210
	111.125 (4.3750)	38.100 (1.5000)	36.975 (1.4550)	30.162 (1.1875)	3.5 (0.14)	3.3 (0.13)	142400	179500	3600	4800	535	532A
	112.713 (4.4375)	30.133 (1.1875)	26.909 (1.0594)	20.638 (0.8125)	0.8 (0.03)	3.3 (0.13)	105800	139500	4500	6000	55176C	55443
45.242 (1.7812)	77.788 (3.0625)	19.842 (0.7812)	19.842 (0.7812)	15.080 (0.5937)	3.5 (0.14)	0.8 (0.03)	56300	71900	4600	6200	LM603049	LM603011
45.618 (1.796)	82.931 (3.265)	23.812 (0.9375)	25.400 (1.0000)	19.050 (0.7500)	3.5 (0.14)	2.3 (0.09)	76700	98400	4500	6000	25590	25520
47.625 (1.875)	88.900 (3.5000)	20.638 (0.8125)	22.225 (0.8750)	16.513 (0.6501)	3.5 (0.14)	1.3 (0.05)	77300	92100	4100	5500	369S	362A
	95.250 (3.7500)	30.162 (1.1875)	29.370 (1.1563)	23.020 (0.9063)	3.5 (0.14)	3.3 (0.13)	109000	149100	4000	5300	HM804846	HM804810
49.987 (1.9680)	112.713 (4.4375)	30.1875 (30.162)	26.909 (1.0594)	20.638 (0.8125)	3.5 (0.14)	3.3 (0.13)	105800	139500	4500	6000	55187C	55443
53.975 (2.1250)	114.981 (4.5268)	65.085 (2.6524)	26.909 (1.0594)	44.445 (1.7500)	2.3 (0.09)	0.50-Ch.	105800	139500	4500	6000	55194	55452D
	107.950 (4.2500)	36.512 (1.4375)	36.957 (1.4550)	28.575 (1.1250)	3.5 (0.14)	3.3 (0.13)	142400	179500	3600	4800	539	532X
	123.825 (4.8750)	36.512 (1.4375)	32.791 (1.2910)	25.400 (1.0000)	3.5 (0.14)	3.3 (0.13)	157400	193000	2900	3900	72212C	72487

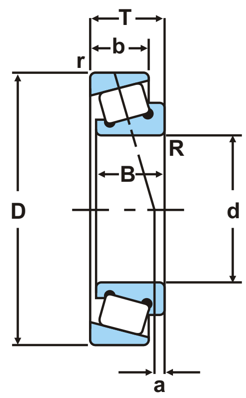
SINGLE ROW TAPERED ROLLER BEARING



INCH SERIES

Bearing Number		Abutment and Fillet Dimensions						Load Centre	Mass (Approx.)
Cone	Cup	D_s mm (inch)	D_1 mm (inch)	d_h mm (inch)	d_1 mm (inch)	R_1 mm (inch)	r_1 mm (inch)	a mm (inch)	Kg (lb)
LM501349	N1006	53.0 (2.09)	46.5 (1.83)	67.0 (2.64)	70.0 (2.76)	3.5 (0.14)	0.8 (0.03)	3.3 (0.13)	0.320 (0.705)
LM501349	LM501310	53.0 (2.09)	46.5 (1.83)	67.0 (2.64)	70.0 (2.76)	3.5 (0.14)	0.8 (0.03)	3.3 (0.13)	0.325 (0.716)
24780	24720	54.0 (2.13)	47.0 (1.85)	68.0 (2.68)	72.0 (2.83)	3.5 (0.14)	0.8 (0.03)	4.5 (0.18)	0.430 (0.948)
25577	25523	55.0 (2.17)	49.0 (1.93)	72.0 (2.83)	77.0 (3.03)	3.5 (0.14)	2.3 (0.09)	6.2 (0.25)	0.615 (1.356)
HM903249	HM903210	65.0 (2.56)	54.0 (2.13)	81.0 (3.19)	91.0 (3.58)	3.5 (0.14)	0.8 (0.03)	+0.4 (+0.02)	0.976 (2.15)
535	532A	60.0 (2.36)	54.0 (2.13)	95.0 (3.74)	100.0 (3.94)	3.5 (0.14)	3.3 (0.13)	12.2 (0.48)	1.838 (4.052)
55176C	55443	58.7 (2.31)	60.2 (2.37)	90.0 (3.62)	106.0 (4.17)	0.8 (0.03)	3.3 (0.13)	- -	1.500 (3.307)
LM603049	LM603011	57.0 (2.24)	50.0 (1.97)	71.0 (2.80)	74.0 (2.91)	3.5 (0.14)	0.8 (0.03)	2.2 (0.08)	0.358 (0.789)
25590	25520	55.0 (2.17)	49.0 (1.93)	72.0 (2.83)	77.0 (3.03)	3.5 (0.14)	2.3 (0.09)	6.2 (0.25)	0.543 (1.20)
369S	362A	60.0 (2.36)	53.0 (2.09)	81.0 (3.19)	84.0 (3.31)	3.5 (0.14)	1.3 (0.05)	4.0 (0.16)	0.548 (1.208)
HM804846	HM804810	66.0 (2.60)	57.0 (2.24)	81.0 (3.19)	91.0 (3.58)	3.5 (0.14)	3.3 (0.13)	3.7 (0.15)	0.968 (2.13)
55187C	55443	66.5 (2.43)	61.7 (3.62)	92.0 (4.17)	106.0 (4.17)	3.5 (0.14)	3.3 (0.13)	- -	1.415 (3.12)
55194	55452D	66.5 (2.43)	61.7 (3.62)	92.0 (4.17)	106.0 (4.17)	3.5 (0.14)	3.3 (0.13)	- -	3.120 (6.88)
539	532X	68.0 (2.68)	61.0 (2.40)	94.0 (3.70)	100.0 (3.94)	3.5 (0.14)	3.3 (0.13)	12.3 (0.48)	1.45 (3.20)
72212C	72487	77.0 (3.03)	65.9 (2.59)	102.0 (4.57)	116.0 (4.57)	3.5 (0.14)	3.3 (0.13)	+1.5 (+0.06)	2.01 (4.431)

SINGLE ROW TAPERED ROLLER BEARING

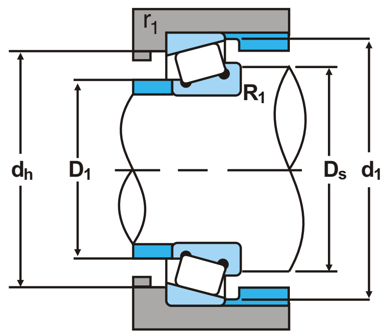


INCH SERIES

Boundary Dimensions							Basic Load Rating (N)		Limiting Speed (rpm)		Bearing Number	
d mm (inch)	D mm (inch)	T mm (inch)	B mm (inch)	b mm (inch)	R mm (inch)	r mm (inch)	Dynamic C	Static Co	Grease	Oil	Cone	Cup
57.150 (2.2500)	104.775 (4.1250)	30.162 (1.1875)	29.317 (1.1542)	24.605 (0.9687)	2.3 (0.09)	3.3 (0.13)	113200	145000	3500	4700	462A	453X
	112.712 (4.4375)	30.162 (1.1875)	30.162 (1.1875)	23.813 (0.9375)	8.0 (0.31)	3.3 (0.13)	150600	217200	3200	4200	39581	39520
59.985 (2.3616)	109.985 (4.3301)	29.751 (1.1713)	28 (1.1024)	23.813 (0.9375)	2.4 (0.09)	1.5 (0.06)	114800	167000	3200	4300	3977 X (X32212)	3922X (X32212)
	134.983 (5.3143)	35.862 (1.4119)	30.925 (1.2175)	21.948 (0.8641)	3.5 (0.14)	3.5 (0.14)	144000	168000	2700	3600	HM911244	HM911216
63.500 (2.5000)	110.000 (4.3307)	29.370 (1.1563)	30.048 (1.1830)	23.020 (0.9063)	7.1 (0.28)	1.5 (0.06)	114800	167000	3200	4300	3982X	3927XA
	112.712 (4.4375)	30.163 (1.1875)	30.048 (1.1830)	23.813 (0.9375)	7.1 (0.28)	3.3 (0.13)	114800	167000	3200	4300	3982X	3920
	122.238 (4.8125)	38.100 (1.5000)	38.354 (1.5100)	29.718 (1.1700)	7.1 (0.28)	1.5 (0.06)	189000	247500	3100	4100	HM212047	HM212010
	130 (5.1180)	36.937 (1.4542)	33.937 (1.3361)	28.000 (1.1024)	6.5 (0.26)	3.5 (0.14)	174800	216500	2900	3800	JHM513640	JHM513615
64.986 (2.5585)	119.985 (4.7238)	32.751 (1.2894)	30.914 (1.2171)	26.949 (1.0610)	2.3 (0.09)	0.8 (0.03)	150600	217200	3200	4200	39586	39528
65.088 (2.5625)	135.755 (5.3447)	53.975 (2.1250)	56.007 (2.2050)	44.450 (1.7500)	3.5 (0.14)	3.3 (0.13)	264500	354900	2900	3800	6379	6320
66.675 (2.6250)	112.712 (4.4375)	30.162 (1.1875)	30.048 (1.1830)	23.813 (0.9375)	3.5 (0.14)	3.3 (0.13)	114800	167000	3200	4300	3984	3920

NBC BEARINGS

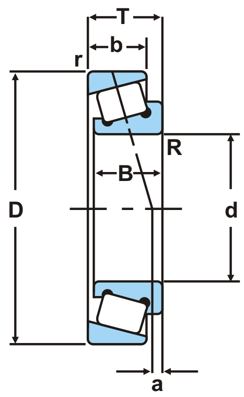
SINGLE ROW TAPERED ROLLER BEARING



SINGLE ROW TYPE
INCH SERIES

Bearing Number		Abutment and Fillet Dimensions						Load Centre	Mass
Cone	Cup	Ds mm (inch)	D1 mm (inch)	dh mm (inch)	d1 mm (inch)	R1 mm (inch)	r1 mm (inch)	a mm (inch)	Kg (lb)
462A	453X	67.0 (2.64)	67.6 (2.66)	92.0 (3.62)	98.0 (3.86)	2.3 (0.09)	3.3 (0.13)	7.1 (0.28)	1.04 (2.29)
39581	39520	81.0 (3.19)	66.0 (2.60)	103.0 (4.06)	107.0 (4.21)	8.0 (0.31)	3.3 (0.13)	6.6 (0.26)	1.315 (2.889)
3977 X (X32212)	3922X (X32212)	72.0 (2.83)	69.0 (2.72)	101.5 (4.00)	104 (4.09)	2.3 (0.09)	0.4 (.015)	3.3 (0.13)	1.200 (2.65)
HM911244	HM911216	84.0 (3.31)	74.4 (2.93)	112.0 (4.41)	123.0 (4.84)	3.5 (0.14)	3.5 (0.14)	7.7 (0.31)	2.423 (5.342)
3982X	3927XA	77.7 (3.06)	71.4 (2.81)	101.5 (4.00)	104.0 (4.09)	7.1 (0.28)	1.5 (0.06)	3.3 (0.13)	1.100 (2.43)
3982X	3920	77.7 (3.06)	71.4 (2.81)	99.0 (3.90)	106.0 (4.17)	7.1 (0.28)	3.3 (0.13)	3.3 (0.13)	1.214 (2.676)
HM212047	HM212010	87.0 (3.43)	73.0 (2.87)	110.0 (4.33)	116.0 (4.57)	7.1 (0.28)	1.5 (0.06)	10.9 (0.43)	1.933 (4.26)
JHM513640	JHM513615	80.0 (3.15)	73.0 (2.87)	113 (4.49)	124 (4.88)	6.5 (0.26)	3.5 (0.14)	7.7 (0.31)	2.25 (4.96)
39586	39528	76.0 (2.99)	72.0 (2.83)	106.2 (4.18)	111.0 (4.37)	2.3 (0.09)	0.8 (0.03)	6.6 (0.26)	1.500 (3.307)
6379	6320	84.0 (3.31)	77.4 (3.05)	117.0 (4.61)	126.0 (4.96)	3.5 (0.14)	3.3 (0.13)	18.8 (0.74)	3.598 (7.932)
3984	3920	80.0 (3.15)	74.0 (2.91)	99.0 (3.90)	106.0 (4.17)	3.5 (0.14)	3.3 (0.13)	4.5 (0.18)	1.142 (2.518)

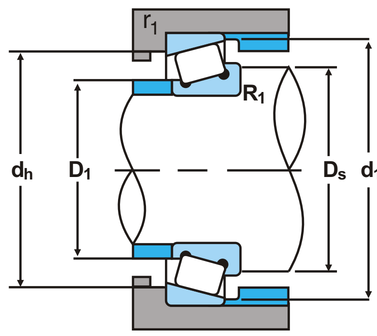
SINGLE ROW TAPERED ROLLER BEARING



SINGLE ROW TYPE
INCH SERIES

Boundary Dimensions							Basic Load Rating (N)		Limiting Speed (rpm)		Bearing Number	
d mm (inch)	D mm (inch)	T mm (inch)	B mm (inch)	b mm (inch)	R mm (inch)	r mm (inch)	Dynamic C	Static Co	Grease	Oil	Cone	Cup
69.850 (2.7500)	120.000 (4.7244)	29.794 (1.1730)	29.007 (1.1420)	24.237 (0.9542)	3.5 (0.14)	2.0 (0.08)	133200	188500	3000	4000	482	472
	127.000 (5.0000)	36.512 (1.4375)	36.170 (1.4240)	28.575 (1.1250)	3.5 (0.14)	3.3 (0.13)	164100	231300	2900	3800	566	563
69.865	120	32.545	32.545	26.195	3.56	3.3	150100	219600	2900	3600	47487	47420
71.438 (2.8125)	127.000 (5.0000)	36.512 (1.4375)	36.170 (1.4240)	28.575 (1.1250)	3.5 (0.14)	3.3 (0.13)	164100	231300	2900	3800	567A	563
73.025 (2.875)	127.000 (5.0000)	36.512 (1.4375)	36.170 (1.424)	28.575 (1.125)	3.5 (0.14)	3.3 (0.13)	164100	231300	2900	3800	567	563
76.200 (3.0000)	139.992 (5.5115)	36.512 (1.4375)	36.098 (1.4212)	28.575 (1.1250)	5.1 (0.20)	3.3 (0.13)	173100	256800	2600	3400	575A	572
80.000 (3.1496)	140.000 (5.5118)	35.250 (1.3878)	33.000 (1.2992)	28.000 (1.1024)	3.0 (0.12)	3.0 (0.12)	183900	281400	2500	3400	M32216A	M32216E
82.550 (3.2500)	136.525 (5.3750)	30.162 (1.1875)	29.769 (1.1720)	22.225 (0.8750)	3.5 (0.14)	3.3 (0.13)	129100	190400	2600	3500	495	493
	139.700 (5.5000)	36.512 (1.4375)	36.098 (1.4212)	28.575 (1.1250)	3.5 (0.14)	3.3 (0.13)	173100	256800	2600	3400	580	572X
	139.992 (5.5115)	36.512 (1.4375)	36.098 (1.4212)	28.575 (1.1250)	3.5 (0.14)	3.3 (0.13)	173100	256800	2600	3400	580	572
95.25	168.28	41.28	41.28	30.16	3.5	3.2	223800	346200	2100	2800	683	672

SINGLE ROW TAPERED ROLLER BEARINGS



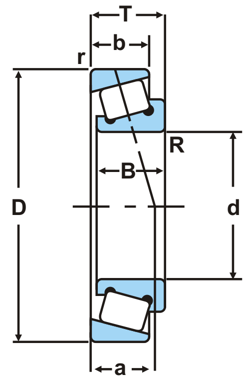
SINGLE ROW TYPE
INCH SERIES

Bearing Number		Abutment and Fillet Dimensions						Load Centre	Mass (Approx.)
Cone	Cup	Ds mm (inch)	D_1 mm (inch)	d_h mm (inch)	d_1 mm (inch)	R_1 mm (inch)	r_1 mm (inch)	a mm (inch)	Kg (lb)
482	472	83.0 (3.27)	70.0 (3.03)	107.0 (4.21)	114.0 (4.49)	3.5 (0.14)	2.0 (0.08)	4.0 (0.16)	1.32 (2.91)
566	563	85.0 (3.35)	78.0 (3.07)	112.0 (4.41)	120.0 (4.72)	3.5 (0.14)	3.3 (0.13)	8.3 (0.33)	1.90 (4.19)
47487	47420	-	-	-	-	-	-	26.80	1.478
567A	563	86.0 (3.39)	80.0 (3.15)	112.0` (4.41)	120.0 (4.72)	3.5 (0.14)	3.3 (0.13)	8.3 (0.33)	1.85 (4.08)
567	563	88.0 (3.46)	81.0 (3.19)	112.0 (4.41)	120.0 (4.72)	3.5 (0.14)	3.3 (0.13)	8.3 (0.33)	1.825 (4.02)
575M	572	92.0 (3.62)	86.0 (3.39)	125.0 (4.92)	133.0 (5.24)	5.1 (0.20)	3.3 (0.13)	5.5 (0.22)	2.325 (5.126)
M32216A	M32216E	90.0 (3.54)	90.0 (3.54)	130.0 (5.12)	134.0 (5.28)	2.0 (0.08)	2.0 (0.08)	4.25 (0.17)	2.192 (4.833)
495	493	97.0 (3.82)	90.0 (3.54)	122.0 (4.80)	130.0 (5.12)	3.5 (0.14)	3.3 (0.13)	0.7 (0.03)	2.02 (4.453)
580	572X	98.0 (3.86)	91.0 (3.58)	125.0 (4.92)	133.0 (5.24)	3.5 (0.14)	3.3 (0.13)	5.5 (0.22)	2.138 (4.713)
580	572	98.0 (3.86)	91.0 (3.58)	125.0 (4.92)	133.0 (5.24)	3.5 (0.14)	3.3 (0.13)	5.5 (0.22)	2.138 (4.713)
683	672	113.0	106.0	149.0	160.0	3.5	3.3	3.0	3.642

NBC BEARINGS

BEARING DESIGNATION

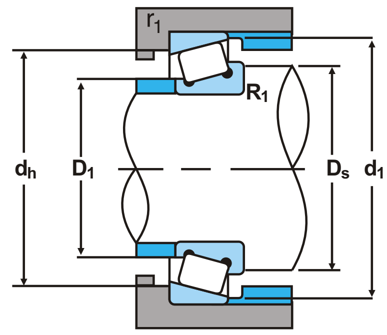
SINGLE ROW TAPERED ROLLER BEARING



SINGLE ROW TYPE
METRIC SERIES

Boundary Dimensions (mm)							Basic Load Rating (N)		Limiting Speed (rpm)		Bearing Number
d	D	T	B	b	R	r	Dynamic C (N)	Static Co (N)	Grease	Oil	
15	42	14.25	13.0	11.0	1.5	1.5	23600	21200	9000	13000	30302
17	40	13.25	12.0	11.0	1.0	1.0	20100	19800	9900	13000	30203
20	42	15.00	15.0	12.0	0.6	0.6	26100	29500	9500	13000	32004X
21.5	47	16.5	16.5	13.0	1.0	1.0	36100	41100	9500	13000	N1061
	47	15.25	14.0	12.0	1.5	1.5	28800	29700	8800	12000	30204
25	47	15	15	11.5	3.3	0.6	28600	35300	7900	11000	32005
25	47	15	15	11.5	3.3	0.6	28600	35300	7900	11000	32005X1N
25	47	17.00	17.0	14.0	0.6	0.6	32500	40500	7900	11000	33005
	52	16.25	15.0	13.0	1.5	1.5	32300	34900	7300	9800	30205
	62	18.16	19.05	14.29	2.0	1.3	46000	45900	6100	8200	30305
	62	18.25	17.0	14.0	1.5	2.2	41500	41500	6000	8000	30305C
	62	25.25	24.0	20.0	2.0	2.0	62600	66000	6700	8900	32305
25	84.985	18.5	18.25	17	1.5	0.3	59000	65400	7900	11000	N1062
30	62	17.25	16.0	14.0	1.0	1.0	43900	48500	6300	8400	30206
	72	20.75	19.0	14.0	1.5	2.2	58400	57800	5700	7600	30306C
32	58	17	17	13	1	1	37000	46500	6600	8700	320/32X
35	62	18.0	18.0	14.0	1.5	0.5	42300	53800	6100	8100	32007X
	72	18.25	17.0	15.0	2.0	2.0	52700	57600	5500	7400	30207
	72	24.25	23.0	19.0	2.0	2.0	86700	98300	5300	7100	M32207
	72	28.0	28.0	22.0	1.5	1.5	76200	79000	5000	6600	30307
	80	32.75	31.0	25.0	2.5	2.5	97200	108700	5000	6600	32307
40	72	18.25	17.0	15.0	2.0	2.0	62500	69200	4900	6000	30208
	80	32.0	32.0	25.0	1.5	1.5	78200	93100	4900	6600	32208
	90	25.25	23.0	20.0	2.5	0.8	100000	114000	4200	5600	30308
	90	35.25	33.0	27.0	2.5	2.5	117300	141600	4400	5900	32308
40	95	27.5	25	19	2	1.5	93400	104300	4400	5900	331257
	68	19.00	19.0	14.5	1.0	1.0	50500	65800	5300	7100	32008X
45	85	20.75	19.0	16.0	2.0	2.0	60800	67900	4400	5900	30209
	85	24.75	23.0	19.0	2.0	0.8	90000	100000	4400	5900	32209
	100	27.25	25.0	18.0	2.5	2.5	98700	112300	3600	4500	31309
	100	38.35	36.0	30.0	2.5	2.5	142900	175600	4000	5300	32309
50	80	24.0	24.0	19.0	1.5	1.0	69300	105000	4400	5800	33010
	90	21.75	20.0	17.0	1.5	1.5	78500	95400	4000	5300	30210
	90	24.75	23.0	19.0	1.5	1.5	83700	103400	4000	5300	32210
55	95	30.0	30.0	23.0	2.0	2.0	111100	156800	3900	5200	33111
	100	26.75	25.0	21.0	2.5	2.5	107000	132300	3600	4900	32211
60	130	33.5	31.0	26.0	3.5	3.5	169900	195400	3000	4000	30312
60	135	33.5	30.95	22	3.5	3.3	157400	185300	3000	4000	330632C
65	120	24.75	23.0	20.0	2.0	1.5	125000	150200	3100	4200	30213
	120	32.75	31.0	27.0	2.5	2.5	155200	198700	3100	4200	32213
70	125	26.25	24.0	21.0	2.5	2.5	125500	152700	2900	3900	30214
	125	35.25	31.0	27.0	2.0	1.5	161000	210700	2900	3900	32214
75	130	27.25	25.0	22.0	2.5	2.5	140800	178700	2700	3600	30215
80	140	28.25	26.0	22.0	3.0	3.0	139800	167200	2500	3400	30216
	140	35.25	33.0	28.0	3.0	3.0	173100	256800	2500	3400	32216
95	145	39.0	39.0	32.5	2.5	2.5	220450	370000	2300	3100	33019

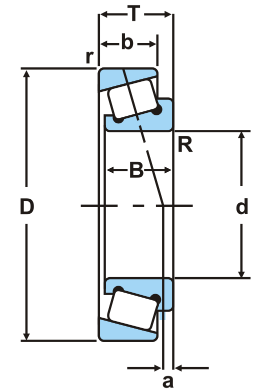
BEARING DESIGNATION
SINGLE ROW TAPERED ROLLER BEARING

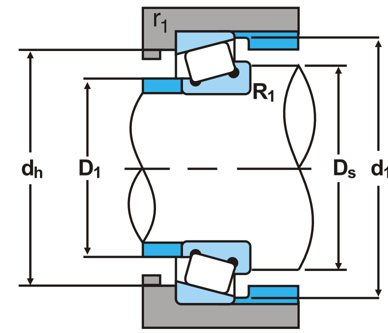


SINGLE ROW TYPE
METRIC SERIES

Bearing Number	Abutment and Fillet Dimensions						Load Center	Mass kg (Approx.)
	D_s min	D_1 max	d_h max	d_h min	d_1 min	R_1 r_1 max	a (mm)	
30302	21	22	36	35	38	1	9.5	0.090
30203	22.5	23	34.5	33	38	1	9.5	0.08
32004X	24.5	25	37.5	36	39	0.6	10.5	0.097
30204	26	26	41	40	44	1	11.5	0.121
33005	29.5	29	42.5	40	43.5	0.6	11.0	0.130
30205	31	31	46	44	48	1	12.5	0.148
30305	32.5	30.5	56	-	59	1	12.5	0.250
30305C	34	30	52	50	59	1.5	16	0.264
32305	32	32	55	52	57	1	16	0.381
30206	35.5	37	56.5	53	57	1	13.5	0.241
30306C	37	40	65	62	66	1	18.33	0.381
32007X	41	40	56	54	59	1	15.5	0.224
30207	42	44	65	62	67	1	15	0.315
32207B	43	40.5	65	-	68	1	20.14	0.457
30307	43.5	42	63.5	61	68	1.5	18.5	0.518
32307	43.5	43	71.5	66	74	1.5	20.5	0.728
30208	48.5	49	71.5	69	75	1.5	16.5	0.435
32208	48.5	48	71.5	68	75	1.5	19.0	0.522
30308	48.5	52	81.5	77	82	1.5	49.5	0.769
32308	48.5	50	81.5	73	82	1.5	23	1.016
32008X	45.5	46	62.5	60	65	1.0	15	0.273
30209	52	54	78	74	80	1	18	0.495
32209	52	53	78	73	81	1	20	0.607
31309	54	56	79	-	95	1.5	32	0.938
32309	53.5	56	91.5	82	93	1.5	25.5	1.36
33010	55.5	56	74.5	72	76	1	17.50	0.433
30210	58.5	58	81.5	79	85	1.5	19.5	0.552
32210	58.5	58	81.5	78	85	1.5	21	0.648
33111	63.5	62	86.5	83	91	1.5	22	0.846
32211	63.5	63	91.5	87	95	1.5	22.5	0.824
30312	72	77	118	112	120	2	26.5	1.930
30213	75	77	115.5	106	113	1.5	23.5	1.18
32213	73.5	75	111.5	104	115	1.5	27	1.50
30214	78.5	81	116.5	110	118	1.5	25.5	1.22
32214	80.0	80	116.5	110	118	1.5	25.5	1.58
30215	83.5	85	121.5	115	124	1.5	27	1.41
30216	90	91	130	124	132	2	27.5	1.72
32216	90	90	130	122	134	2	31	2.18
33019	105	104	136.5	131	139	1.5	28.5	2.270

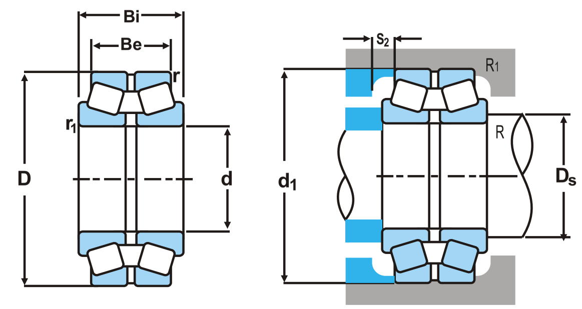
SINGLE ROW TAPERED ROLLER BEARING





Boundary Dimensions (mm)							Basic Load Rating (N)		Bearing Number		Abutment and Fillet Dimensions						Mass kg (Approx.)
d	D	T	B	b	R	r	Dynamic C	Static Co	Cone	Cup	D_s	D_1	d_h	D_1	R_1	r_1	
101.60	190.50	57.15	57.3	44.45	8.0	3.3	385200	565200	861	854	129	114	170	174	8.0	3.3	7.0
110.0	200	56	53	46	3.5	3.5	388100	546000	32222	32222	122	126	188	170	2.0	-	7.7
114.3	212.73	66.68	66.68	53.98	7.0	3.3	472200	691200	938	932	141	128	187	193.1	7.0	3.3	10.1
120.65	182.56	39.69	38.10	33.34	3.5	3.3	226400	441000	48282	48220	137	131	168	176	3.5	3.3	3.69
127	182.56	39.69	38.10	33.34	3.5	3.3	226400	441000	48290	48220	141	135	168	176	3.5	3.3	3.32
127	228.60	53.975	49.428	38.10	3.4	3.3	414400	592500	HM926747	HM926710	156	143	200	219	3.5	3.3	8.83
139.7	236.538	57.15	56.642	44.45	3.5	3.3	492000	814600	HM231132	HM231110	-	-	-	-	-	-	-
155.575	336.550	85.725	79.375	53.975	6.35	6.0	856300	1235100	H936340	H936313	-	-	-	-	-	-	-
165.1	336.55	92.07	95.25	69.85	3.3	6.4	1155000	1696100	HH437549	HH437510	193.6	192.1	288.9	307.9	3.2	6.35	39.0
174.63	247.65	47.62	47.62	38.10	3.5	3.3	341500	693500	67787	67720	192.1	185.7	225.4	239.7	3.5	3.3	7.23
177.8	260.35	53.975	53.975	41.275	8.0	3.2	445900	816700	M236848	M236810	204	191	241	149	8.0	3.3	9.24
180	250	47	45	37	3.0	2.5	376100	728400	JM736149	JM736110	196	190.5	232	242.6	3.0	2.5	6.70
	380	98	88	60	5.0	5.0	1089800	1490900	27336	27336	-	-	-	-	-		46.0
190	260	46	44	36.50	3.0	2.5	363300	715900	JM738249	JM738210	206	200	242	252	3.0	2.5	6.80
190.5	266.70	47.63	46.83	38.10	3.5	3.3	347100	727700	67885	67820	209.5	203.2	241.3	258.7	3.5	3.3	8.0
	336.55	98.43	95.25	73.02	6.4	6.4	1003200	1804600	HH840249	HH840210	228.6	206.4	282.5	319.1	6.4	6.4	37.3
200	420	108	97	66	6.0	6.0	1293200	1863700	27340	27340	-	-	-	-	-	-	63.0
206.38	336.55	98.43	100.01	77.79	3.3	3.3	1110900	2031200	H242649	H242610	228.6	223.8	303.2	317.5	3.3	3.3	34.28
220	340	76.50	72	62	4.0	4.0	858000	1440100	2007144	2007144	-	-	-	-	-	-	22.3
220.662	314.325	61.912	66.675	49.212	1.60	5.00	625000	1239000	M244249A	N1060	-	-	-	-	-	-	
221.170	314.325	61.912	66.675	49.212	1.60	5.00	625000	1239000	N1059	M244210	-	-	-	-	-	-	
228.6	320.68	50.8	49.21	33.34	6.4	3.3	402000	742800	88900	88126	254	241.3	299	308	6.4	6.4	12.66
255.600	342.900	57.150	63.500	44.450	1.53	3.30	614100	1282400	M349547	M349510	-	-	-	-	-	-	13.795
257.175	358.775	71.438	76.200	53.975	1.53	3.30	818500	1663600	M249747	M249710	-	-	-	-	-	-	20.65
260	360	64.5	60	52	3.5	3.5	695600	1323200	2007952	2007952	-	-	-	-	-	-	17.70
300	460	100.7	95	82	5.0	5.0	1477500	2609700	2007160	2007160	-	-	-	-	-	-	55.9
900	1180	124	122	87	8.0	8.0	3241500	8375100	10079/900	10079/900	-	-	-	-	-	-	330.0
	1280	190	170	135	10.0	10.8	6330900	13199500	71/900	71/900	-	-	-	-	-	-	703.0
1320	1600	174	165	142	8.0	8.0	6539100	21281100	20078/1320	20078/1320	-	-	-	-	-	-	719.0
710	950	114	106	80.80	8.0	3.5	2882200	6186500	10079/710	10079/710	-	-	-	-	-	-	195.0
190.5	428.625	106.362	95.25	61.912	6.4	3.3	1082400	1446000	EE350750	351687	237	240	366	383	6.4	6.4	63.1
247.65	406.4	115.89	219.675	93.662	6.4	3.3	1601100	3099500	HH249949	HH249910	275	284	366	383	6.4	6.4	60.2

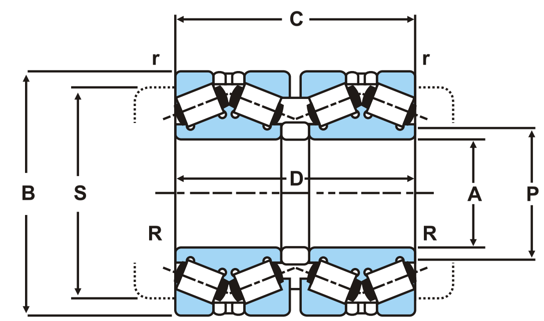
DOUBLE ROW TAPERED ROLLER BEARING



Boundary Dimensions (mm)						Basic Load Rating (N)		Bearing Number		Abutment and Fillet Dimensions					Type	Mass kg (Approx.)
d	D	Bi	Be	r	r1	Dynamic C	Static Co	Cone	Cup	D_s min	D_1 min	S_2 max	R_1 min	R_1 max		
99.98	196.85	103.38	74.42	3.6	1.5	548200	780700	HM821547	HM821511D	120.6	187.3	14.48	3.6	1.5	TDO	14.65
104.78	180.98	104.78	85.73	3.5	1.5	496300	876500	782	774D	120.6	166.7	9.53	3.5	1.5	TDO	11.24
	180.98	104.78	85.73	3.5	1.5	496300	876500	NA782	774D	-	-	-	-	-	TNA	11.24
130	230	150	120	4.0	1.5	920500	1682300	97526	97526	-	-	-	-	-	TDO	25.3
142.88	200.03	93.66	73.03	3.5	0.76	372700	986200	NA48686	48620D	-	-	-	-	-	TNA	8.43
150	270	172	138	4.0	1.5	1350900	2388000	97530	97530	-	-	-	-	-	TDO	39.10
159.95	244.48	107.95	79.37	3.5	1.5	589100	1069000	81630	81963D	-	-	-	-	-	TDO	18.18
190.50	266.70	103.19	84.14	3.5	0.8	609270	1500000	67885	67820D	-	-	-	-	-	TDO	17.70
220	340	165	130	4.0	1.5	1550200	3081100	2097144	2097144	-	-	-	-	-	TDO]	48.0
240	400	210	168	5.0	2.0	1486900	2236700	2097748	2097748	-	-	-	-	-	TDO	98.0
260	360	134	109	3.5	1.2	1192600	2646500	2097952	2097952	-	-	-	-	-	TDO	36.8
	400	186	146	5.0	2.0	1752900	3731800	2097152	2057152	-	-	-	-	-	TDO	76.8
	420	170	-	5.0	5.0	2075900	4035800	47752	47752	-	-	-	-	-	TDI	88.5
300	420	160	128	4.0	1.5	1714300	3952200	2097960	2097960	-	-	-	-	-	TDO	62.9
305.08	500	200	-	5.0	4.0	2221000	4684900	N1021	N1021	-	-	-	-	-	TDI	154.6
340	460	160	128	4.0	1.5	1725500	4092700	2097968	2097968	-	-	-	-	-	TDO	71.0
346.07	488.95	200.02	158.75	6.35	1.5	3021300	6311800	HM262749	HM262710D	377.8	466.7	20.6	6.35	1.5	TDO	117.60
380	620	242	170	6.0	2.5	2021800	3469400	1097776	1097776	-	-	-	-	-	TDO	243.0
384.18	546.1	222.25	117.8	6.35	1.5	3217500	8250500	HM266449	HM266410D	415.9	520.7	22.225	6.35	1.5	TDO	165.0
400	600	206	150	6.0	2.5	2770200	6059500	97180	97180	-	-	-	-	-	TDO	180.0
406.4	539.75	142.88	101.6	6.35	1.5	1355400	3229400	EE234160	234213D	434.9	515.9	20.64	635	1.5	TDO	88.8
420	700	275	200	8.0	3.5	4537900	9253900	1097784	1097784	-	-	-	-	-	TDO	406.0
460	680	230	175	8.0	3.5	3435400	7588300	97192	97192	-	-	-	-	-	TDO	253.0
480	650	180	130	6.0	2.5	2251900	5544500	1097996	1097996	-	-	-	-	-	TDO	151.0
488.95	660.4	206.38	158.75	6.35	1.5	3115400	8002800	EE640192	640261D	523.9	630.2	23.81	6.35	1.5	TDO	200.0
500	720	216	-	8.0	8.0	3139900	7625300	40471/500	40471/500	-	-	-	-	-	TDI	285.0
560	750	213	156	6.0	2.5	3162700	8059800	10979/560	10979/560	-	-	-	-	-	TDO	235.0
	820	242	-	8.0	11.0	4375200	11527000	8471/560	8471/560	-	-	-	-	-	TDI	427.0
600	800	210	160	6.0	2.5	3462000	9846200	10979/600	10979/600	-	-	-	-	-	TDO	242.0
	870	270	198	8.0	3.5	5397600	10530700	971/600	971/600	-	-	-	-	-	TDO	500.0
609.6	793.75	206.38	158.75	6.35	1.5	3462000	9846200	EE649240	649313D	644.5	755.6	23.81	6.35	1.5	TDO	262.0
710	950	240	175	8.0	3.5	4778200	12382700	10979/710	10979/710	-	-	-	-	-	TDO	415.0
762	965.2	187.33	133.35	6.35	1.5	3392100	10084800	EE752300	752381D	800.1	923.9	26.19	6.35	1.5	TDO	324.0
950	1250	300	220	10.0	4.0	7379500	20474100	10979/950	10979/950	-	-	-	-	-	TDO	930

Type : TDO = Double cup, two single cones with cone spacer Type : TDI = Double cup, two single cones without cone spacer TDA = Double cup, two single cones with cone spacer.

FOUR ROW TAPERED ROLLER BEARING

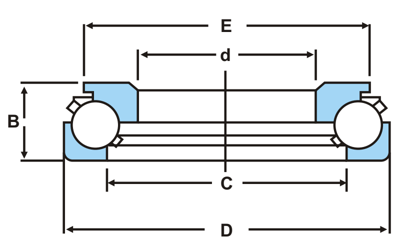


TAPERED BORE BEARING

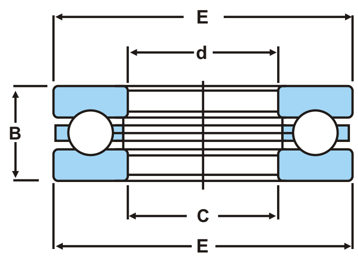
Boundary Dimensions (mm)						Basic Load Rating (N)		Bearing Number			Type	Mass kg (Approx.)
A	B	C	D	R	r	Dynamic C	Static Co	Cone	Cup Single	Cup Double		
177.8	247.65	192.09	192.0	1.5	3.3	1009600	2768300	67790	67720	67721D	TQO	28.13
180.843	284.162	101.60	239.715	3.3	1.5	1473200	3662700	M240631T/ 644TD/647T	-	M240611D	TQIT	60.00
200	340	305	305	4.0	4.0	2522162	5760800	2077144	2077144	2077144	TQO	104.00
260	440	128	330	5.0	5.0	3277200	7624400	477752	477752	-	TQIT	196.00
266.7	355.6	228.6	230.19	1.6	3.2	1835200	5324400	LM451349DW	LM451310	LM451310D	TQO	65.50
279.578	380.90	244.48	244.48	1.5	3.2	1973100	6020300	LM654644D	LM654610	LM654610D	TQO	81.67
280.27	379.89	244.48	244.48	1.5	3.2	1983800	5972100	N1028	N1028	N1028	TQO	79.20
285.75	380.90	244.48	244.48	1.5	3.2	1983800	5972100	LM654648DW	LM654610	LM654610D	TQO	76.42
343.05	457.10	254	254	1.6	3.2	2415600	6751700	LM761649DW	LM761610	LM761610D	TQO	110.00
406.40	546.10	288.93	288.93	1.5	6.35	3615700	10571900	LM767749DW	LM767710	LM767710D	TQO	185.00
480	700	77	420	6.0	2.5	5468800	15466600	577796	577796	-	-	537.00
489.02	634.87	320.68	320.68	3.3	3.3	4326600	14091800	EE243193DW	243250	243251D	TQO	270.00
500	720	420	420	8.0	8.0	6760900	18275200	771/500	771/500	771/500	TQO	560.00
	830	570	570	10.0	10.0	1099330	26624700	10777/500	10777/500	10777/500	TQO	1250.0
558.8	736.60	322.26	322.26	3.3	6.35	5422600	16120100	EE843221D	843290	843291D	TQO	375.00
600	800	365	365	6.0	6.0	5935600	19692400	779/600	779/600	779/600	TQO	531.00
630	920	515	515	10.0	10.0	9900300	27582300	771/630	771/630	771/630	TQO	1160.0
660.4	812.8	365.13	365.13	3.2	6.4	6238200	23300600	L281149D	L281110	L281110D	TQO	420.0
670	1090	710	710	10.0	10.0	18936300	49719400	N1014D	N1015	N1016D	TQO	2660.0
750	1130	690	690	10.0	10.0	17120500	50489200	777/750	777/750	777/750	TQO	2550.0
939.8	1333.5	939.8	939.8	4.8	12.5	25477200	70767000	LM287849D	LM287810	LM287810D	TQO	4390.0

Type : TQO = One double cup, two single cups, with two cup spacers, two double cones with one cone spacer.
Type : TQIT = Two double cups with cup spacer, one tapered double cone & two tapered single cone.

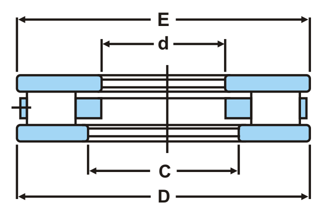
THRUST BEARING



TL SERIES



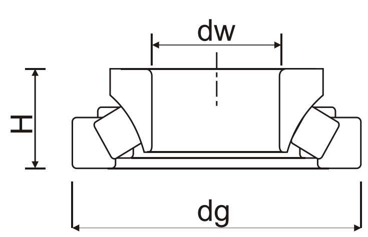
BALL THRUST



ROLLER THRUST

Boundary Dimensions (mm)						Bearing Number	Basic Load Rating (N)		Type	Weight Kg (Approx.)
d	C	D	E	B	r		Dynamic C	Static Co		
110	165	230	188	73	4.0	TL-110	237400	520800	TL Series	11.34
120	179	250	206	78	4.0	TL-120	268900	615900	TL Series	14.58
140	203	280	234	85	5.0	TL-140	297300	737800	TL Series	18.86
160	233	320	266	95	5.0	TL-160	366600	989700	TL Series	28.12
340	341	540	540	160	6.0	8368	1121100	4439800	TL Series	148.00
630	631	850	850	175	8.0	82/630	1326600	8040500	Ball Trust	252.00
670	672	800	800	105	5.0	81/670	858200	5489600	Ball Trust	105.00
710	711	950	950	185	8.0	N-1013	1214600	8018200	Roller Thrust	407.00
76.2	82.55	119.84	116.66	25.4	-	T624	156300	466600	Roller Thrust	1.07
88.9	90.47	138.89	129.36	33.32	-	AT-626	166500	528000	Roller Thrust	1.87
152.4	154	254	252.4	50.8	4.0	9923	715810	3214123	Roller Thrust	10.30
304.8	307.18	609.6	607.22	114.3	9.5	N-1011	3906711	23041514	Roller Thrust	157.0
460	460	800	800	206	-	9889492	5613300	32882600	Roller Thrust	435.00
203.2	203.2	419.1	419.1	92.075	9.7	T-811-TTHD	2490000	10600000	Roller Thrust	-

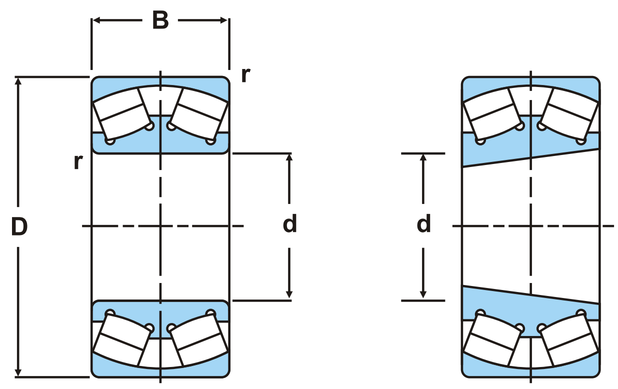
THRUST SPHERICAL ROLLER BEARING



Spherical roller thrust bearings can accommodate heavy axial load, they are adapted to high speeds
These bearings are fitted with assymmetrical barrel shaped roller.

Bearing Number	Dimension			Application	Weight kg .
	dw	Dg mm	H		
509043	26.5	57.0	14.8	Telco Trucks Steering wheel	0.11

SPHERICAL ROLLER BEARINGS



Cylindrical bore

Tapered bore (K)
(1:12)

METRIC SERIES

Boundary Dimensions (mm)				Bearing Number	Basic Load Rating (N)	
d	D	B	r		Dynamic C	Static Co
60	130	46	2.1	22312, 22312K *	238000	273000
70	150	51	2.1	22314, 22314K *	325000	380000
75	130	31	1.5	22215, 22215K *	190000	246000
100	215	73	3.0	22320, 22320K	599100	727200
110	200	53	2.1	22222, 22222K *	410000	570000
130	280	93	4.0	22326, 22326K	1043000	1343600
140	300	102	4.0	22328	1110000	1430000

* Sizes are also available with oil groove on outer ring.

UNITS SPECIFIED IN SI SYSTEM

Force

1 KN (Kilo newton)	=	1000N	=	102Kgf		
1 Kgf	=	9.81N				

Pressure

1 bar	=	10 N/cm^2	=	1.02 Kg/cm^2		
1 Kgf/mm^2	=	9.81 N/cm^2	=	0.981 bar		

Stress Contact Pressure

1 N/mm^2	=	1 Mpa (Mega pascal)				
	=	0.102 Kgf/mm^2				
1 Kgf/mm^2	=	9.81 N/mm^2				

Torque

1 Nm	=	0.102 Kgf-m				
1 Kgf-m	=	9.81 Nm				

Energy

1 J (Joule)	=	1 Nm	=	1Ws (Watt Second)		
	=	0.102 Kgf-m				
1 Kgf-m	=	9.81 ws	=	9.81 Nm		
			=	9.81 J		

Power

1 W	=	1J/s	=	1 Nm/s	=	0.102 Kgf-m/s
1 KW	=	1.36 PS	=	102 Kgf-m/s		
1 PS	=	0.736 KW	=	75 Kgf-m/s		
1 Kgf-m/s	=	9.81 N-m/s	=	9.81 J/s		
	=	9.81 W				

Kinematic Viscosity

1mm^2/s	=	1cst (Centi stoke)				

STEEL BALLS

INCH SIZE		METRIC SIZES	
Basic Diameter	Weight per 1000 balls in kg	Basic Diameter	Weight per 1000 balls in kg
7/64	0.08722	3	0.1102
1/8	0.1302	3.5	0.1769
5/32	0.2543	4	0.2630
3/16	0.4395	4.5	0.3707
7/32	0.6979	5	0.5086
15/64	0.8583	5.5	0.6804
1/4	1.042	6	0.8788
17/64	1.250	6.5	1.1295
9/32	1.483	7	1.4107
5/16	2.035	7.5	1.7418
11/32	2.708	8	2.1001
3/8	3.516	8.5	2.522
13/32	4.469	9	3.003
7/16	5.582	10	4.110
15/32	6.867	11	5.489
31/64	7.576	12	7.121
1/2	8.333	13	9.027
17/32	9.996	14	11.295
9/16	11.87	15	13.73
19/32	13.96	16	16.78
5/8	16.28	17	20.18
21/32	18.84	18	24.00
11/16	21.66	20	32.88
23/32	24.75	21	38.10
3/4	28.13	22	43.82
25/32	31.79	23	49.90
13/16	35.77	24	56.70
		25	64.41
27/32	40.05		
7/8	44.66		
29/32	49.62		
15/16	54.93		
31/32	60.61		
1	66.67		

CONVERSION TABLES.

INCHES TO MILLIMETERS. FRACTIONS.

Inches		mm	Inches		mm
1/64	.015625	.03969	33/64	.515626	13.0969
1/32	.03125	.7937	17/32	.53125	13.4937
3/64	.046875	1.1906	35/64	.546875	13.8906
1/16	.0625	1.5875	9/16	.5625	14.2875
5/64	.78125	1.9844	37/64	.578125	14.6844
3/32	.09375	2.3812	19/32	.59375	15.0812
7/64	.109375	2.7781	39/64	.609375	15.4781
1/8	.125	3.1750	5/8	.625	158750
	.140625	3.5719	41/64	.640625	16.2719
5/32	.15825	3.9687	21/32	.65625	16.6637
11/64	.171875	4.3658	43/64	.671875	17.0656
3/16	.1875	4.7625	11/16	.6875	17.4625
13/64	.201325	5.1594	45/64	703125	17.8594
7/32	.21875	5.5562	23/32	71875	18.2562
15/64	.234375	5.9531	47/64	734375	18.6531
1/4	.25	6.3500	3/4	75	19.0500
17/64	.255625	6.7469	49/64	765625	19.4469
9/32	.28125	7.1437	25/32	78125	19.8437
19/64	.296875	7.5408	51/64	796875	20.2406
5/16	.3125	7.9375	13/16	8125	.206375
21/64	.328125	8.3344	53/64	828125	21.0344
11/32	.34375	8.7312	27/32	84375	21.4312
23/64	.359375	9.1281	55/64	859375	21.8281
3/8	.375	9.5250	7/8	875	22.2250
25/64	.390625	9.9219	57/64	890625	22.6219
13/32	.40625	10.3187	29/32	90625	23.0187
27/64	.421875	10.7156	59/64	921875	23.4156
7/16	.4375	11.1125	15/16	9375	23.8125
29/64	.413125	11.5094	61/64	953125	24.2094
15/32	.46875	11.9062	31/32	69875	24.6062
31/64	.484375	12.3030	63/64	984375	25.0031
1/2	.5	12.7000			

MILLIMETERS TO INCHES UNITS.

mm		10	20	30	40	50	60	70	80	90
0		.39370	.78740	1.18110	1.57480	1.96851	2.36221	2.75591	3.14961	3.54331
1	.03937	.43360	.82677	1.22047	1.61417	2.00788	2.40158	2.79528	3.18898	3.58288
2	07874	.47244	.86614	1.25984	1.65354	2.044.95	2.83465	3.22835	3.22835	3.62205
3	.11811	.51181	.90551	1.29921	2.08662	2.08662	2.48034	2.87402	3.26772	3.66142
4	.15748	.55118	.94488	1.33858	1.73228	2.12599	2.15969	2.91339	3.30709	3.70079
5	.19685	.59055	.98425	1.37795	1.77165	2.16536	2.55906	2.95276	3.34646	3.74016
6	.23622	.62992	1.02362	1.41732	1.81103	2.20473	2.59843	2.99213	3.38583	3.77953
7	.27559	.66929	1.06299	1.45669	1.85040	2.24410	2.63780	3.03150	3.42520	3.81890
8	.31496	.70866	1.10236	1.49606	1.88977	2.28347	2.67717	3.07087	3.46457	3.85827
9	.35433	.74803	1.14173	1.53543	1.92914	2.32284	2.71654	3.11024	3.50395	3.89764

mm		100	200	300	400	500	600	700	800	900
0		3.93701	7.87402	11.8110	15.7480	19.6851	23.6221	27.5591	31.4961	35.4331
10	.39370	4.33071	8.26772	12.2047	16.1417	20.0788	24.0158	27.9528	31.8898	35.8268
20	.78740	4.72441	8.66142	12.5984	16.5354	20.4725	24.4095	28.3465	32.2835	36.2205
30	1.18110	5.11811	9.05513	16.9921	16.9291	20.8662	24.8032	28.7402	32.6772	36.6142
40	1.57480	5.51181	9.44883	13.3858	17.3228	21.2599	25.1969	29.1339	33.0709	37.0079
50	1.96851	5.90552	9.84252	13.7795	17.7165	21.6536	25.5906	29.5276	33.4646	37.4016
60	2.36221	6.29922	10.2362	14.1732	18.1103	22.0473	25.9843	29.9213	33.8583	37.7953
70	2.75591	6.69292	10.6299	14.5669	18.5040	22.4410	26.3780	30.3150	34.2520	38.1890
80	3.14961	7.08662	11.0236	14.9606	18.8977	22.8347	26.7717	30.7087	34.6457	38.5827
90	3.54331	7.48032	11.4173	15.3543	19.2914	23.2284	27.1654	31.1024	35.0394	38.9764

FRACTIONS

mm	Inch	mm	Inch	mm	Inch
0.001	.000039	0.01	.00039	0.01	.0039
0.002	.000079	0.02	.00079	0.02	.0079
0.003	.000118	0.03	.00118	0.03	.0118
0.004	.000157	0.04	.00157	0.04	.0157
0.005	.000197	0.05	.00197	0.05	.0197
0.006	.000236	0.06	.00236	0.06	.0236
0.007	.000276	0.07	.00276	0.07	.0276
0.008	.000315	0.08	.00315	0.08	.0315
0.009	.000354	0.09	.00354	0.09	.0354

mm	Inch	mm	Inch	mm	Inch
0.011	.0254	.01	.254	.1	2.54
.002	.0508	.02	.508	.2	5.08
.003	.0762	.03	.762	.3	7.62
.004	.1016	.04	1.016	.4	10.16
.005	.1270	.05	1.270	.5	12.70
.006	.1524	.06	1.524	.6	15.24
.007	.1778	.07	1.778	.7	17.78
.008	.2032	.08	2.032	.8	20.32
.009	.2286	.09	2.286	.9	22.86

Inch		mm		
		10	20	30
0		2540	508.0	762.0
1	25.4	279.4	533.4	787.4
2	50.8	304.8	558.8	812.8
3	76.2	330.2	584.2	838.2
4	101.6	355.6	609.6	863.6
5	127.0	381.0	635.0	889.0
6	152.4	406.4	660.4	914.4
7	177.8	431.8	685.8	939.8
8	203.2	457.2	711.2	965.2
9	228.6	482.6	736.6	990.6

Hardness conversion table (reference)

		BRINELL HARDNESS		ROCKWELL HARDNESS		
Rockwell hardness C scale 1471.0N (150kgf)	Vicker's hardness	Standard steel ball	Tungsten carbide steel ball	A scale 588.4N (60kgf)	B scale 980.7N (100kgf)	Shore hardness
68	940			85.6		97
67	900			85.0		95
66	865			84.5		92
65	832		739	83.9		91
64	800		722	83.4		88
63	772		705	82.8		87
62	746		688	82.3		85
61	720		670	81.8		83
60	697		654	81.2		81
59	674		634	80.7		80
58	653		615	80.1		78
57	633		595	79.6		76
56	613		577	79.0		75
55	595	-	560	78.5		74
54	577	-	543	78.0		72
53	560	-	525	77.4		71
52	544	500	512	76.8		69
51	528	487	496	76.3		68
50	513	475	481	75.9		67
49	498	464	469	75.2		66
48	484	451	455	74.7		64
47	471	442	443	74.1		63
46	458	432	432	73.6		62
45	446	421	421	73.1		60
44	434	409	409	72.5		58
43	423	400	400	72.0		57
42	412	390	390	71.5		56
41	402	381	381	70.9		55
40	392	371	371	70.4	-	54
39	382	362	362	69.9	-	52
38	372	353	353	69.4	-	51
37	363	344	344	68.9	-	50
36	354	336	336	68.4	(109.0)	49
35	345	327	327	67.9	(108.5)	48
34	336	319	319	67.4	(108.0)	47
33	327	311	311	66.8	(107.5)	46
32	318	301	301	66.3	(107.0)	44
31	310	294	294	65.8	(106.0)	43
30	302	286	286	65.3	(105.5)	42
29	294	279	279	64.7	(104.5)	41
28	286	271	271	64.3	(104.0)	41
27	279	264	264	63.8	(103.0)	40
26	272	258	258	63.3	(102.5)	38
25	266	253	253	62.8	(101.5)	38
24	260	247	247	62.4	(101.0)	37
23	254	243	243	62.0	100.0	36
22	248	237	237	61.5	99.0	35
21	243	231	231	61.0	98.5	35
20	238	226	226	60.5	97.8	34
(18)	230	219	219	-	96.7	33
(16)	222	212	212	-	95.5	32
(14)	213	203	203	-	93.9	31
(12)	204	194	194	-	92.3	29
(10)	196	187	187		90.7	28
(8)	188	179	179		89.5	27
(6)	180	171	171		87.1	26
(4)	173	165	165		85.5	25
(2)	166	158	158		83.5	24
(0)	160	152	152		81.7	24

1 Meter = 39.370113 inches
1 Inch = 25.399978 millimeters

National Engineering Industries Ltd.
Jaipur

Manufacturers of Steel balls, Rollers, Ball bearing,
Roller bearing and Axle Boxes.

NATIONAL ENGINEERING INDUSTRIES LTD.

KHATIPURA ROAD, JAIPUR - 302 006
Phone : 2223221 Fax : (0141) 2221926, 2222259
E-mail : neisales@neibearing.com
Website : www.neibearing.com

KOLKATA
Birla Building, 11th Floor,
9/1 R.N. Mukherjee Road, Kolkata - 700 001
Phone : 22420910, 22430383
Fax : 033-22101912, 22489110
E-mail : neical@neibearing.com

NEW DELHI
Birla Tower, 7th Floor,
25, Barakhamba Road, New Delhi - 110001
Phone : 55308700, 01 Telefax : 011-55308700
E-mail : neidli@neibearing.com

MUMBAI
Mehta Building, 26, Calicut Street,
Ballard Estate, Mumbai - 400 038
Phone : 22677761 Fax : (022) 22677714
E-mail : neimum@neibearing.com

CHENNAI
7A, 2nd Floor, Wellingdon Estate,
53, Ethiraj Salai, Chennai - 600 008
Phone : 28270289, 28255696 Fax : (044) 28266640, 28255434
E-mail : neichn@neibearing.com

PUNE
210, Century Arcade, 243-244,
Narangi Baug Road, Pune - 411 001
Phone : 26122145, 26122469
Fax : (020) 26122066
E-mail : neipune@neibearing.com

NBC
BEARINGS

Designed & Printed by : Globe Calendar Corporation 011-23522333